Chapter 3

RESEARCH PROCEDURES

The data for our test of a macro approach to estimating intrinsic water quality benefits was gathered in 1576 personal interviews of a national probability sample of persons 18 years of age and older. The sample was designed and the interviews were conducted by the Roper Organization. Interviewing took place in two waves: 1289 people were interviewed in late January - early February 1980 and 287 in March 1980.[1] The sampling plan was a multistage probability sample. Once an eligible person was identified, as many as four attempts were made to arrange an interview. Seventy-three percent of the individuals selected were ultimately interviewed. A description of the sampling design is contained in Appendix V.

For the entire sample, the chances are 95 out of 100 that the results on a particular question are within 2 to 3 percentage points of the results that would have been obtained from a very large sample selected and interviewed in a similar manner.

National surveys are very expensive to conduct. We were able to minimize the costs of this experiment by taking advantage of an ongoing survey. After the interview for the original survey was completed, the interviewers administered our sequence of benefits questions. From the respondents' perspective, the two interviews appeared as one long interview.

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[1] It was originally intended that all the interviewing would be done in the initial period, but the survey contractor had an unanticipated shortfall in interviews which went unrecognized for a month. This necessitated further interviewing to bring the sample up to 1500.

While this procedure allowed us to have our instrument field tested in a way that was completely satisfactory, budgetary constraints limited the number of questions we could ask and prevented us from preparing a set of briefing materials for the interviewers. Consequently, as will be discussed at length in later chapters, the percent of respondents who failed to give the interviewers the amount they were willing to pay for the levels of water quality was high, as was the percent who gave zero bids. In this chapter we describe the context of the survey and the instrument. Subsequent chapters discuss the reliability and validity of the responses and the values people have for water quality. The final chapter presents a plan for revising the procedures to improve the measures and increase the response rate to the wtp questions.

Context

The RFF water benefits questions took about 10-15 minutes to administer. They were preceded by a separate half-hour survey on environmental issues which was conducted for another study. Since the questions for this other study set the context for the water benefit questions it is important to outline briefly their content and results.

We will discuss the possible biasing effect they may have had at a later point in this report.

The environmental survey consisted of some 100 items which probed the respondent's views about national priorities, environmental protection, the regulation of risks, energy issues, values, and views about government and the environmental movement. A number of these items were repeated from earlier surveys for trend purposes. This survey sought to probe beneath the respondent's presumed predisposition towards environmental protection (as consistently shown by other national surveys) by asking questions which: a) forced the respondent to rank order the environment among other national priorities, b) measured concern about economic issues and energy shortages, and c) which forced the respondent to choose between tradeoffs (e.g. environment vs. growth or environmental quality vs. lower cost of regulation). The questionnaire for the environmental survey which preceded the benefits questions, including the background questions used for both studies, is in Appendix IV.

When the respondents were forced to rank order problems in terms of which should have the most government priority, "reducing pollution of air and water" fell to sixth place (out of 10 problems) from the second place position it held at the time of the original Earth Day in 1970. Responses to other questions in the environmental survey showed the respondents were extremely concerned about inflation, energy problems, and defense. Nevertheless, while the environment is apparently no longer viewed as a crisis issue, overall support for environmental protection showed continued strength in the trend and tradeoff questions, a finding confirmed by subsequent surveys.[2]

[2]For a description of the findings of the environmental survey see Public Opinion on Environmental Issues (Council on Environmental Quality, 1980).

The data from the environmental survey are part of our benefits data file and were used in our analysis of the benefits data. The environmental survey included several questions about water quality issues. The respondents were asked:

1. How worried or concerned they are with "cleaning up our waterways and reducing water pollution." Thirty-nine percent said they were concerned "a great deal," and at the opposite extreme 16 percent said they were concerned not much or not at all about water pollution. (See Q.11c, Appendix IV for the marginals and comparisons across other areas of concern in 1980).
2. Their judgment about the quality of the water in the "lakes and streams in this area" on a self-anchored 11 step ladder for the present, past (five years ago) and the future (five years from now). Q.18-20. From this set of questions it is possible to calculate their optimism or pessimism about change in local water quality over time.
3. How far in miles the nearest freshwater lake and river large enough for boating are from their home (Qs. 33a and b).
4. A series of questions on use of water (Qs. 58-66) For boating, swimming and fishing in a freshwater lake or stream, respondents were asked whether they had engaged in each activity in the past two years, if so whether they did it within fifty miles of their home, and how many times they did it during this time period. We used these questions for our measures of recreational water use.

Water Pollution Ladder and Value Levels

The levels of water quality for which we sought WTP estimates are "boatable," "fishable," and "swimmable." We described these levels in words and depicted them graphically by means of a water quality ladder. Use of these categories, two of which are embodied in the law mandating the national water pollution control program, allowed us to avoid the methodological problems we would have faced had we chosen to describe water in terms of the numerous abstract technical measures of pollution. Although the boatable-fishable-swimmable categories are widely understood by the public, they did require further specification on our part to ensure that people perceived them in a similar fashion.

We defined boatable water in the text of the question as an intermediate level between water which "has oil, raw sewage and other things in it, has no plant or animal life and smells bad" on the one hand and water which is of fishable quality on the other. Fishable water covers a fairly large range of water quality. Game fish like bass and trout cannot tolerate water that certain types of fish such as carp and catfish flourish in. In our pretests we initially experimented with two levels of fishable water -- one for "rough" fish like carp or catfish and the other for game fish like bass -- but we were forced to abandon this distinction because people were confused by it. We adopted a single definition of "fishable" as water "clean enough so that game fish like bass can live in it" under the assumption that the words "game fish" and "bass" had wide recognition and connoted water of the quality level Congress had in mind. Swimmable water appeared to present less difficulty

for popular understanding since the enforcement of water quality for swimming by health authorities has led to widespread awareness that swimming in polluted water can cause sickeness to humans.

Because WTP questions have to describe in some detail the conditions of the "market" for the good they are inevitably longer than the usual survey research questions. Respondents quickly become bored and restless if material is read to them without giving them frequent opportunities to express judgments or to look at visual aids. We designed the RFF instrument to be as interactive as possible by interspersing the text with questions which required the respondents to use the newly described water quality categories. We also handed them a water quality ladder card which was referred to constantly during the sequence of benefits questions.

Figure 3.1 shows the card. The ladder is similar to the self-anchoring ladder used earlier in the interview. The top, step 10, was called the "best possible water quality" and the bottom, step 0, was the "worst possible water quality." This time, however, we anchored it by designating five levels of water quality at different steps on the ladder. Level E, at .8, was specified as a point on the ladder where the water was even unfit for boating although the active range below 2.5 was described as being of this quality. Level D, 2.5, was where it became okay for boating; C at 5 was fishable, B at 7 was swimmable and 9.5 was identified as A where the water is safe to drink. These numerical positions were estimated by indexing a set of five objective scientific water quality parameters using a variant of the National Sanitation Foundatin's Water Quality Index (Booth et al.,

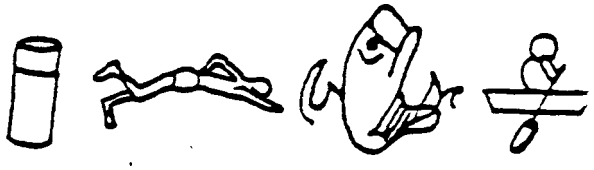
Figure 3.1

B (WATER QUALITY LADDER CARD) #684

BEST POSSIBLE
WATER QUALITY

10

A SAFE TO DRINK



9

8

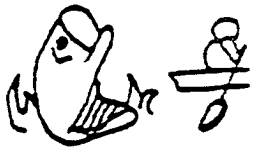
7

B SAFE FOR SWIMMING

6

5

C GAME FISH LIKE BASS CAN LIVE IN IT



4

3

D OKAY FOR BOATING

2

1

E

0

WORST POSSIBLE
WATER QUALITY

1976; McClelland, 1974). The method is described in Appendix II. Although this is necessarily a tenuous scaling procedure, it yielded a set of positions which appear reasonable. Our pretests showed that respondents did not seem to be sensitive to changes of one or two rungs in the location of the water quality levels along the scale.

We introduced the market and the ladder in the following manner:

> This last group of questions is about the quality of water in the nation's lakes and streams. Comgress passed strict water pollution control laws in 1972 and 1977. As a result many communities have to build and run new modern sewage treatment plants and many industries have to install water pollution control equipment.
>
> Here is a picture of a ladder that shows various levels of the quality of water. (HAND RESPONDENT WATER QUALITY LADDER CARD) Please keep in mind that we are not talking about the drinking water in your home. Nor are we talking about the ocean. We are talking only about freshwater lakes, rivers and streams that people look at and in which they go boating, fishing and swimming.
>
> The top of the ladder stands for the best possible quality of water, that is, the purest spring water. The bottom stands for the worst possible quality of water. Unlike the other ladders we have used in this survey, on this ladder we have marked different levels of the quality of water. For example . . . . (POINT TO EACH LEVEL: E, D, C, AND SO ON, AS YOU READ STATEMENTS BELOW)
>
> > Level E (POINTING) is so polluted that it has oil, raw sewage and other things in it, has no plant or animal life and smells bad
> >
> > Water at level D is okay for boating but not for fishing or swimming
> >
> > Level C shows where rivers, lakes and streams are clean enough so that game fish like bass can live in them
> >
> > Level B shows where the water is clean enough so that people can swim in it safely
> >
> > And at level A, the quality of the water is so good that it would be possible to drink it directly from a lake or stream if you wanted to

We thus defined the environmental good as freshwater lakes, rivers and streams and distinguished it from drinking water and salt water. We specifically invoked visual values as well as the active use values of boating, fishing and swimming.

Our intention was to obtain a WTP estimate for national water quality. In order to get the respondent to think about the national situation the interviewer next asked:

> Now let's think about all of the nation's rivers, lakes and streams. Some of them are quite clean and others are more or less polluted. Looking at this ladder, would you say that all but a tiny fraction of the nation's rivers, lakes and streams are at least at level D in the quality of their water today or not?

Strictly speaking, the law mandates water cleanup for all freshwater bodies. We substituted "all but a tiny fraction" for "all" in this and the following questions because we did not want to unnecessarily complicate the issue by having respondents speculate about the impossibility of every portion of every water body in the nation being at a certain water quality level at all times. Six out of ten respondents agreed that today all but a fraction of the nation's freshwater bodies are at level D while 17 percent were not sure and 20 percent felt that level had not yet been reached.

The next section of the instrument was meant to introduce the respondent to two things: 1) the fact that water pollution control costs money and 2) that the level of cleanup is a matter of preference. We did this by asking the following question:

81. As you know it takes money to clean up our nation's lakes and rivers. Taking that into account, and thinking of overall water quality where all but a tiny fraction of the nation's lakes and rivers are at a particular level, which level of overall water quality do you think the nation should plan to reach within the next five years or so -- level E, D, C, B, or A?

Eighty-five percent chose a goal of fishable or better (C, B, or A) while 57 percent chose swimmable or better (B or A).

Payment Vehicle

We used two principal criteria to choose our payment vehicle. The first is realism -- the vehicle should match the way people actually pay for higher water quality as closely as possible. The second criteria is conservativism -- every effort should be made to avoid a false overstatement of willingness to pay. Conservativism in question design is important because unless respondents are made to pay the amounts they offer, WTP studies are inevitably hypothetical in character. The bias associated with hypothetical situations is towards overstating the amount the person is willing to pay[3] although the amount of overstatement is not necessarily large (Bohm, 1972) and is sometimes nonexistent (Davis, 1980). Given many economists' fear that the WTP methodology is biased upward, the findings of WTP questions will be credible only if every effort is made to avoid this bias. Our procedure was to design our instrument so that, whenever possible, any bias present is toward lowering rather than raising the WTP amount.

We selected annual household payment in higher prices and taxes as our payment vehicle because this is the way people pay for water pollution control programs. A portion of each household's annual federal tax payment

[3] See Chapter 4.

goes towards the expense of regulating water pollution and providing construction grants for sewage treatment plants. Local sewage taxes pay for the maintenance of three plants. Those private users who incur pollution control expenses, such as manufacturing plants, ultimately pass much or all of the cost along to consumers in higher prices. This payment vehicle is conservative because:

- Ever since the passage of Proposition 13 in California in 1977, opposition to the current level of taxes is a commonly expressed attitude which is socially acceptable (even normative). Concern about inflation was the nation's "most important problem" according to polls taken at the time of the RFF survey. Thus we can assume the words "taxes and higher prices" will not be taken lightly by our respondents and may, for some, have a highly charged negative connotation.
- By asking for the annual amount a person is willing to pay instead of for a monthly amount, we avoid the possibility of an “easy payment plan" underestimation.

Starting Point

Our review of the literature on micro WTP studies and on survey research more generally, identified starting point bias as a particularly serious problem for our study. Because of this we developed and tested an alternative to the commonly used bidding game WTP method. In this section we outline the problems presented by the bidding game technique and describe our alternative procedure -- the payment card method.

The widely used bidding game format for WTP studies uses a sequence of yes/no questions and normally requires the interviewer to begin the bidding process by offering an initial amount. The subsequent bids flow from that point, albeit in either direction. If the amount presented influences the respondent's final bid in some systematic way -- starting point bias -- we have a serious problem.

There are a priori reasons for suspecting such a bias in this type of situation. The tendency of respondents to give a socially desirable answer (Edwards, 1957; Dohrenwend, 1966; Phillips and Clancy, 1970, 1972) or to acquiesce when confronted with questions using a yes/no agree or disagree format (Couch and Keniston, 1960; Campbell et al., 1967; Carr, 1977; Jackman, 1973; and Phillips and Clancy, 1970) is well documented. Accordingly, when valuing a public good like water quality, a respondent may be reluctant to reject a starting bid even when it is higher than he is willing to pay for fear of appearing cheap or lacking a social conscience (social desirability effect) and/or because of a tendency on the part of the respondent to agree with suggestions offered by the interviewer (acquiescence effect).

In practice, strong starting point effects have been found by some researchers doing micro WTP studies (Rowe et al., 1979) although other researchers have not found them (Thayer, et al., forthcoming; Brookshire, et al., 1979; Brookshire et al., 1980). Where starting point bias has been discovered, the effect of higher starting points is to raise the mean WTP amount.

The acquiescence effect shows a strong relationship with education -- people with less education are much more likely to acquiesce than those with more education (Jackman, 1973). This introduces a further bias. If we assume, as studies have shown, that WTP varies by income level and that income is correlated with education, then the potential for an education/ WTP interaction effect is strong when a single starting point is used for the entire sample. When choosing a single starting point, the researcher needs one that will be below the expected mean for the entire sample, but not too far below or the process of bidding upward to find the maximum WTP amount will be too laborious. An initial bid which meets this requirement for the entire sample can be expected to be below the mean for people in the $15-25,000 range, close to the mean of the real bid for someone in the $8,000-14,999 income range and above the real mean bid for those with lower incomes. Since many people in the lower income range will also have low educations, in this situation they are likely, by the operation of the acquiescence effect, to overbid for the good in question. The reverse is less likely to happen for those with an income above $25,000 because their educational level is higher (on the average) and therefore their propensity for acquiescence in the interview situation is lower. Thus even if the overall starting bias described earlier is not present, overstatement of benefits by lower income people will bias the WTP amounts upwards.

A further problem with the bidding game technique is that the process of iterating from a starting point to a final WTP amount can be tedious if the starting point lies some distance from the respondent's real WTP amount. If the range is narrow -- such that most respondents, for example,

value a certain good at between $1 and $5 per month on their utility bill -- and if the increments are fairly large -- say $1 -- then the process can be accomplished fairly efficiently. When this is not the case, the length of the iteration process can alienate respondents or cause them to cease bidding before reaching their maximum amount.

The problems with the bidding game approach enumerated above are exacerbated for payment vehicles like ours which engender large bids (because they ask for an annual household amount for national water quality) and which are strongly income dependent (owing to the income tax component of the vehicle). Moreover, it seems questionable that the bidding game technique can be used reliably by professional interviewers such as ours who are spread across the country and cannot be personally instructed in its use. For these reasons we developed our payment card technique to elicit the respondent's WTP amounts.

In this technique the respondent is given a card which contains a menu of amounts which begin at $0 and increase by a fixed interval until an arbitrarily determined large amount is reached. When the time comes to elicit the WTP amount, the respondent is asked to pick a number off the card (or any number in between) which "is the <u>most</u> you would be willing to pay in taxes and higher prices <u>each year</u>" (italics in the original) for a given level of water quality. The question asks people to give us the highest amount they are willing to pay and we accepted their answer as representing such an amount. In our pretesting we tried asking people if

they would be willing to pay a higher amount than the one they picked and found some people resented being "pushed" once they had settled on an amount. Others would give us a higher amount but in such a way that we suspected they were acquiescing to interviewer pressure rather than revealing their true consumer surplus.

The payment card has two special features:

1. It is anchored. In our initial pretests we found the respondents had considerable difficulty in determining their willingness to pay when we used a card which only presented various dollar amounts. A number of them expressed embarrasment, confusion, or resentment at the task and some who gave us amounts indicated they were very uncertain about them. We determined that the problem lay with the lack of benchmarks for their estimates. People are not normally aware of the total amounts they pay for public goods even when that amount comes out of their taxes, nor do they know how much they cost. Without a way of psychologically anchoring their estimate in some manner they were not able to arrive at meaningful estimates. They needed benchmarks of some kind which would convey sufficient information without biasing their WTP amounts. We reasoned that the most appropriate benchmarks for WTP for water pollution control would be the amounts they are already paying in higher prices and taxes for other non-environmental public goods. We identified amounts on the card for several such goods and conducted further pretests. These showed the benchmarks made the task meaningful for most people.

The use of payment cards with benchmarks raises the possibility of information bias. Are the respondents who gave us amounts for water pollution

control using the benchmarks for general orientation or are they basing their amounts directly on the benchmarks themselves in some manner? In the former case people would be giving us unique values for water quality; in the latter case they would be giving us values for water quality relative to what they think they are paying for a particular set of other public goods. If the latter case holds and their water quality values are sensitive to changes in the benchmark amounts or to changes in the set of public goods identified on the payment card, their validity as estimates of consumer surplus for water quality are suspect.

We designed our study to test for information bias due to the benchmarks. Four different versions of the payment cards were prepared and administered to approximately equivalent sub-samples. Figures 3.2 shows the cards given to the lower-medium income respondents ($10,000-14,999 annual family income) for the A, B, C, and D versions. These versions varied as follows:

A Benchmarks are shown for the amounts we estimated the average household of that income level contributes to the space program, highways, public education and defense.

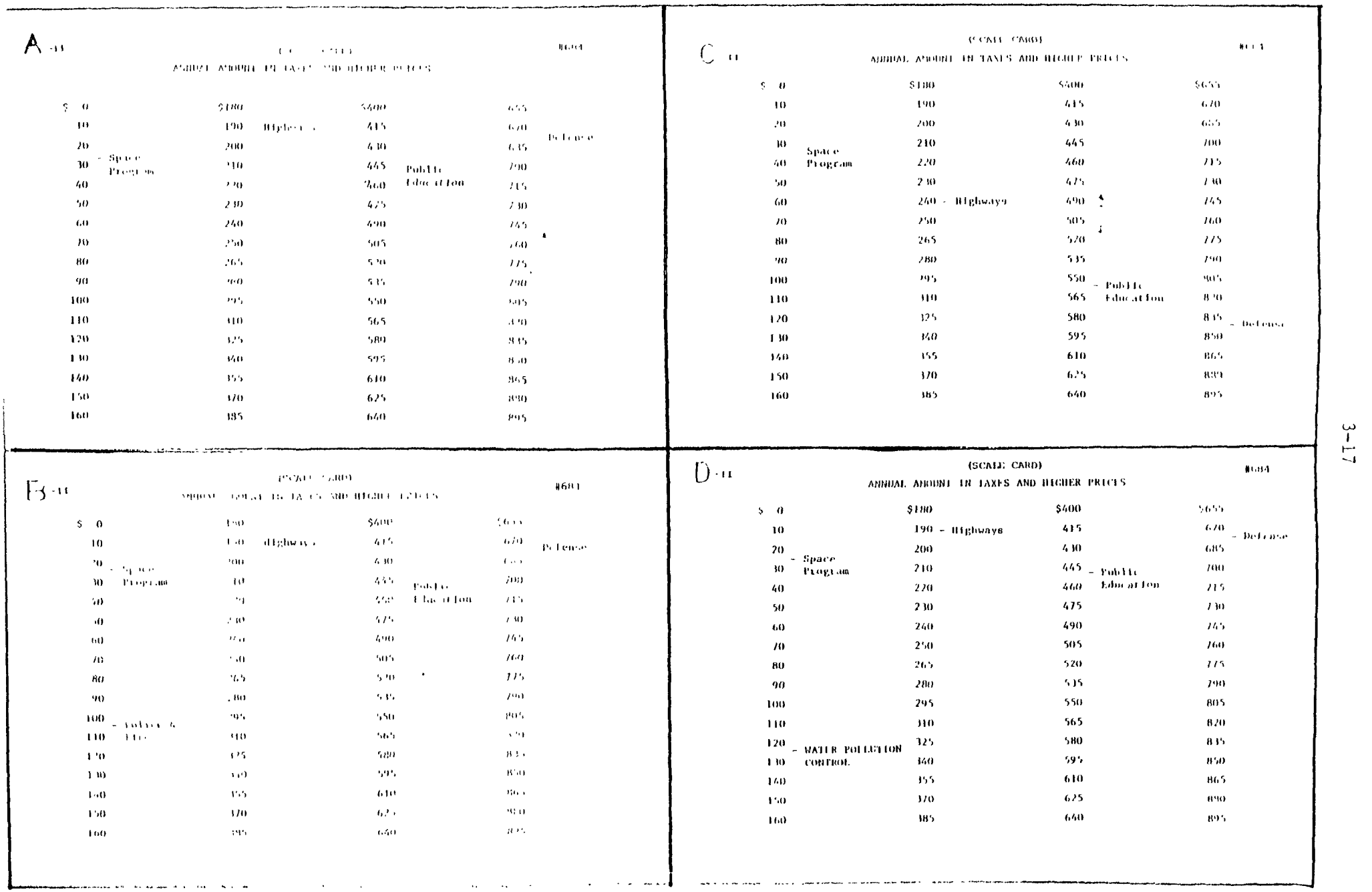
B The same four public goods and amounts as on A plus police and fire protection.

C The same four public goods used in version A were shown, but for amounts 25 percent higher than on version A.

D The same four public goods and amounts as in Version A, plus the estimated amount for water pollution control.

We added the police and fire good in version B to see if the insertion of a new item in the dollar range where water pollution benefits estimates were likely to fall would affect those estimates. Version C seeks to test whether the actual amounts shown for the benchmarks affect the water pollution WTP amounts. We purposely omitted environmental goods in each of the

Figure 3.2 PAYMENT CARDS FOR VERSIONS A, B, C, D FOR PEOPLE WITH FAMILY INCOMES OF $10,000-14,999



first three versions to avoid having people would tell us what they think they should give rather than what they actually want to pay. In version D we added our estimate of what average households are actually paying for water pollution control to see whether this information actually does bias the WTP amounts.

Deriving the dollar estimates for each of our benchmark public goods was a difficult task particularly because we needed them for four income levels as well (see below). A detailed description of our procedures is given in Appendix III. We are satisfied that the estimates are sufficiently close approximations to suffice for this test. If it turned out that people's WTP amounts are very sensitive to the benchmark amounts, then much more effort would be required to improve the accuracy of these estimates.

2. It is income adjusted. For the reasons stated earlier, the amounts people are actually paying for water pollution control vary by income. This is also the case for the other public goods which we used as benchmarks. We corrected for this by developing benchmark goods estimates for four different income categories: I) family income under $10,000; II) $10,000-14,999; III) $15,000-24,999; IV) $25,000 and above. (Appendix I gives our public goods estimates for each of these income categories). Each interviewer therefore had four different payment cards for each of the A, B, C, and D forms. At the appropriate point in the interview the interviewer gave the respondent the payment card for his or her income category. (A question on income preceded the water quality benefits questions.) For the 10 percent of respondents who refused to divulge their income our procedure was to give them the income card for income level IV, the highest income level as people with higher incomes are more likely to refuse to divulge their income.

Figure 3.3 gives the four forms used for Version A. The card for the lowest income category (I) shows an annual defense figure of $325 while those in the highest income category were told they are spending between $3000 and $3075 per year on defense. In order to make the stimuli shown on the payment cards as similar as possible to each of the four income groups we varied the range of potential amounts. Each card shows 60 amounts. Income category I's amounts ranged from $0 to $440 while those for IV were $0 to $3285. These ranges and the intervals (which are wider at the higher levels) were chosen so that the visual pattern of public goods amounts was approximately the same for each income level. In each case the maximum amount on the card is roughly 30 percent greater than the amount shown for defense.

The following is the text of the first WTP question in our instrument. The same text was used for versions A, B, and C with the exception of the additional mention of police and fire in paragraph two for version B.

> 82. Improving the quality of the nation's water is just one of many things we all have to pay for as taxpayers and as consumers. That is, the costs of things like improving water quality are paid partly by government out of what we pay in taxes and partly by companies out of what we pay for the things they sell us.
>
> This scale card shows about how much people in your general income category paid in 1979 in taxes and higher prices for things like national defense, roads and highways, public schools and the space program. (HAND RESPONDENT APPROPRIATE SCALE CARD A-I, A-II, A-III, OR A-IV: LET RESPONDENT KEEP WATER QUALITY LADDER CARD)
>
> You will see different amounts of money listed with words like "highways" and "public education" appearing by the amount of money average size households paid for each one last year. "Highways" here refers to the construction and maintenance of all the nation's highways and roads. "Public education" refers to all public elementary and secondary schools but does not include the costs of public universities.

Figure 3.3 PAYMENT CARDS FOR INCOME LEVELS I-IV FOR VERSION A

A-I

(SCALE CARD) #604

ANNUAL AMOUNT IN TAXES AND HIGHER PRICES

$ 0	$ 75	$150	$300
5	80	160	310
10	85	170	320
15 - Space Program	90	180 - Public Education	330 - Defense
20	95 - Highways	190	340
25	100	200	350
30	105	210	360
35	110	220	370
40	115	230	380
45	120	240	390
50	125	250	400
55	130	260	410
60	135	270	420
65	140	280	430
70	145	290	440

A-II

(SCALE CARD) #604

ANNUAL AMOUNT IN TAXES AND HIGHER PRICES

$ 0	$180	$400	$655
10	190 - Highways	415	670
20	200	430	685 - Defense
30 - Space Program	210	445 - Public Education	700
40	220	460	715
50	230	475	730
60	240	490	745
70	250	505	760
80	265	520	775
90	280	535	790
100	295	550	805
110	310	565	820
120	325	580	835
130	340	595	850
140	355	610	865
150	370	625	880
160	385	640	895

A-III

(SCALE CARD) #604

ANNUAL AMOUNT IN TAXES AND HIGHER PRICES

$ 0	$270	$ 660	$1200
15	285	690	1230
30	300 - Highways	720	1260
45	315	750	1290
60 - Space Program	330	780	1320 - Defense
75	345	810	1350
90	360	840	1380
105	375	870 - Public Education	1410
120	390	900	1440
135	405	930	1470
150	420	960	1500
165	450	990	1530
180	480	1020	1560
195	510	1050	1590
210	540	1080	1620
225	570	1110	1650
240	600	1140	1680
255	630	1170	1710

A-IV

(SCALE CARD) #604

ANNUAL AMOUNT IN TAXES AND HIGHER PRICES

$ 0	$450	$1200	$2550
25	475	1275	2625
50	500	1350	2700
75	525	1425	2775
100	550	1500	2850
125 - Space Program	575	1575	2925
150	600	1650	3000
175	625 - Highways	1725	3075 - Defense
200	650	1800	3150
225	675	1875	3225
250	700	1950 - Public Education	3300
275	725	2025	3375
300	750	2100	3450
325	775	2175	3525
350	800	2250	3600
375	875	2325	3675
400	950	2400	3750
425	1125	2475	3825

> I want to ask you some questions about what amounts of money, if any, you would be willing to pay for varying levels of overall water quality in the nation's lakes, rivers and streams. Please keep in mind that the money would go for sewage treatment plants in communities through various kinds of taxes (such as withholding taxes, sales taxes and sewage fees) and for pollution control equipment the government would require industries to install, thus raising the prices of what they make.
>
> At the present time the average quality of water in the nation's lakes, rivers and streams is at about level D on the ladder. (POINT TO LEVEL D ON WATER QUALITY LADDER CARD) If no more money were spent at all tomorrow on water quality, the overall quality of the nation's lakes and rivers would fall back to about level E. (POINT TO LEVEL E) People have different ideas about how important the quality of lakes, rivers and streams is to them personally. Thinking about your household's annual income and the fact that money spent for one thing can't be spent for another, how much do you think it is worth to you to keep the water quality in the nation from slipping from level D back to level E? That is, which amount on this scale card, or any amount in between, is the most you would be willing to pay in taxes and higher prices each year to keep the nation's overall water quality at level D where virtually all of it is at least clean enough for boating? If it is not worth anything to you, please do not hesitate to say so.

Several aspects of question 82 bear comment. For the purpose of convenience we started the process of demand revelation with the present level of national water quality (boatable) and asked respondents to value a reduction in this quality to level E, non-boatable. (In subsequent questions we had them value hypothetical increases from boatable to fishable and then swimmable.) In this question we expanded the account given in the previous questions about how their money would be used and reinforced the ideas that the WTP amount would be coming out of their annual income and its use for this purpose would preclude other uses of the money. At two points in this question we legitimated a low or zero WTP amount in an effort to minimize the social desirability effect. We noted that "people have different ideas" about the importance of water quality to them personally

and at the conclusion of the question we stated: "If it is not worth anything to you, please don't hestiate to say so."

The response categories which were supplied to the interviewers for this question were:

Write in amount: $_____

Depends (voluntary)

Not sure

Not worth anything

Through a misunderstanding the survey contractor did two things which may have biased the results. First in this and the next question, those who responded "not worth anything" -- in effect a $0 bid -- were not asked how much they were willing to pay for water of higher quality. Instead, the interviewers skipped directly to the last question. Presumably most of the people who valued boatable water at $0 were generally unwilling to pay for water pollution control of any kind and would also have valued fishable and swimmable quality water at $0. Our analysis of the views of these people about water pollution and environmental quality suggests that this conjecture is probably true for most of them. But some of them may indeed only value water nationwide when it reaches the fishable and/or swimmable quality levels. If so, they would have given a WTP amount greater than $0 for the higher levels, if they had the opportunity, despite their $0 bid for the lower level. Second, when the data were keypunched, the contractor restricted the WTP amounts to three colums, thereby limiting the maximum WTP amount to $999. For versions A, B, C combined, 43 People

were recorded as WTP this maximum amount for level B. We have no way of knowing how many of these people actually valued water quality at an amount higher than this. It is our judgment that both these errors have had only a minor effect on our estimates. The direction of the resulting bias is, of course, conservative.

The next question sought the respondents' WTP for fishable water, level C.

> 83. As I mentioned earlier, almost all of the rivers and lakes in the United States are at least at level D in water quality. What do you think it is worth to you not only to keep them from becoming more polluted but also to raise their overall quality to level C? That is, including the amount you just gave me, which amount on the scale card is the most you would be willing to pay in taxes and higher prices each year to raise the overall level of water quality from level D to level C where virtually all of it would at least be clean enough for fish like bass to live in?

The final WTP question used the same format for swimmable water, level B.

> 84. What about getting virtually all of the nation's lakes and rivers up to level B on the ladder? Including the amounts of money you have already given me, which amount on the scale card is the most you would be willing to pay in taxes and higher prices each year to make almost all the nation's lakes, rivers and streams clean enough so that people could swim in them?

In two of the versions, A, and C, we asked the respondents to evaluate the amount of information we provided them about the WTP exercise. We were precluded from asking this of all the respondents because of severe constraints on the length of the questionnaire.

85. Finally, in terms of your being able to decide exactly how much you, yourself, would be willing to pay as a taxpayer and consumer for better water quality, would you say in the last few questions we gave you more than enough information, about enough information, not quite enough, or not enough information at all?

CHAPTER 4

CONTROL FOR BIASES

Prior to discussing our findings it is necessary to examine the character of the data we have gathered. To what extent are they free from bias? The micro willingness-to-pay literature has devoted considerable attention to the potential biases, their effect and how they may be overcome (Schulze, et al., 1980). Table 4.1 lists these potential biases and several others which we believe to be important.

Table 4.1

POTENTIAL BIASES IN WILLINGNESS TO PAY STUDIES

General	Sampling
Strategic	Sample
Hypothetic	Response Rate
Instrument	**Interview**
Starting Point	Item non-response
Payment Vehicle	Interview Procedure
Information	Interviewer
Order	

GENERAL BIASES

Strategic and hypothetic are the two sources of bias of greatest fundamental concern to economists who wish to evaluate the validity of willingness to pay surveys.

Strategic Bias

Its Nature

Strategic bias is the attempt by respondents to influence the outcome of a study in a direction which favors the respondents' interests by deliberately misrepresenting their demand for a good.[1] In 1954, Paul Samuelson argued on free-rider grounds that a person would be motivated to "pretend to have less interest in a given collective consumption activity than he really has" and despaired of finding a way of overcoming this problem (1954). Samuelson assumes that the individual would believe he or she would have to pay the amount he or she declares as being willing to pay. If this assumption is relaxed, as seems reasonable, many economists believe an incentive to overestimate consumption would be prevalent (Freeman,19796:88). For example, take a survey whose respondents believe the mean WTP amount for all respondents will influence the government's provision of a public good and that they will not be obligated to pay their WTP amount. If they value the good, the respondents may attempt to raise the mean (and impose their preference) by overstating their willingness to pay. Robert Crandall seems to have this kind of situation in mind when he wrote: "Such surveys (consumer

[1] See Kutz (1975) for the the theoretical conditions necessary for successful strategic behavior.

surveys) are always biased when the respondent knows that he or she does not have to write a check to confirm the answer" (Crandall, 1979). Conversely, those who do not value the good very highly but assume that many others do, may underestimate their willingness to pay in order to lower the mean and bring it closer to their actual willingness to pay.

Empirical attempts to test for strategic bias in willingness to pay studies and laboratory experiments have consistently failed to find it (Brookshire, et al., 1979:22-23; V.L. Smith, 1977). A much cited challenge to the notion that strategic bias can be overcome in WTP studies is an experiment conducted by Peter Bohm. In one of the few attempts to compare hypothetical WTP questions with the results from identical non-hypothetical situations, Bohm (1972) conducted an experiment where participants bid for the opportunity to see a closed circuit television program. He ran six different versions of the experiment most of which systematically introduced incentives to act strategically in a situation where the respodent actually had to pay their bids. Only one version, Group VI, gave bids which were significantly different from any of the others. Since this group was told that they would not actually have to pay what they bid, Bohm draws the conclusion that "when no payments and/or forced decisions are involved people will act in an irresponsible manner" (Bohm, 1972:125). In other words, when the consequences for respondents are hypothetical they will overbid. Careful examination of Bohm's study shows that this conclusion is unwarranted:

1. Out of five comparisons, Group VI's mean bid was significantly higher in only one case (Group III).
2. Group VI was higher in income than the other groups which may account for the size of its mean payment.
3. Group V also did not have to pay its bid. If strategic bias was operative, there are reasons to think that this group should have had the highest bid of all, but it did not.
4. Unlike the other groups, Group VI had one high outlier (at 50 where the median bid was 10) which raised its mean bid considerably. When the outlier is removed, its mean payment is reduced from 10.19 to 9.45 Kroner and the difference between Group VI and Group III drops below the .05 level of significance. It would appear that only one person of 54 may have acted "irresponsibly." [2]

The incentives to misrepresent preferences are minimal in most WTP surveys because respondents lack either the information necessary to act strategically or the incentive to do so because respondents do not believe they will be directly affected by the study's outcome. Although respondents take valuation questions seriously, most do not think their responses will have an immediate effect on policy nor should they since policy has rarely, if ever, been set in this manner. The now conventional wisdom on strategic bias in WTP surveys was recently summarized by Feenberg and Mills in their recent review of water benefit analysis. They concluded, "It is unlikely that the problem is serious" (Feenberg and Mills, 1980).

[2] We do not believe the one person acted strategically since an incentive to overbid in this situation was not apparent although our colleague, Clifford Russell, believes this to be an example of strategic bias.

Our instrument was designed to minimize possible incentives to engage in strategic behavior. No policy outcome was mentioned in the instrument nor were respondents told how their WTP amounts would be used. Even if respondents inferred that the study's findings are intended for government guidance in some way, most would be aware of the indirect connection between such a study and the actual process by which tax rates and prices are determined. On a priori grounds, therefore, we would not expect strategic bias to affect our results.

(continue)

Distribution Tests for Strategic Bias

Apart from specific experimental tests, two possible indicators of strategic bias, neither of them formalized, have been suggested, A distribution test was first proposed by Brookshire, Ives and Schulze (1976). They hypothesized that the distribution of the WTP amounts (in their case, bids) will be normal when strategic bias is absent. If it is present, they predict a "flattened" distribution. They examined the distribution of responses for their study, which involved the aesthetic benefits of foregoing the siting of a power plant near Lake Powell, and concluded on the basis of observation that since the distribution was "not flat," strategic behavior was unlikely.

This distribution test has several weaknesses.

1. Even if we accept the notion that non-strategically biased distributions should be normal it is impossible for most WTP distributions to pass the standard statistical tests for normality such as the Komogorov-Smirnov test.[2] These tests assume that each data point has an equal probability of being chosen, but since respondents tend to choose favorite numbers (e.g., 5, 10, 20, 25 rather than 6, 11, 22, etc.), the resulting distribution is always too lumpy to pass the test even though the distribution may appear to approximate a normal distribution.

[2]Clifford Russell has recently called our intention to a grouped data normality test (Burlington and May, 1958:180-181) which may be an appropriate normality test for these kinds of data.

2. The expectation that strategic behavior will flatten an otherwise normal (or approximately normal) distribution is well founded, but only if the distribution of those who value the public good in question is normally distributed. In certain situations there is reason to doubt that non-biased WTP amount distributions will be normal. Imagine a population, most of whom are either environmental enthusiasts or enthusiasts for industrial growth at the lowest possible cost. If they all act strategically, we will get a bi-modal rather than a flat distribution with the environmentalists' amounts accumulating at the high end and the industrial enthusiasts' at the other end.

3. Since income is the primary deterrent of willingness to pay and since the distribution of income more clearly approximates a log normal curve[3] than the normal curve. In the absence of strategic bias, the distribution one would expect in this situation would be closer to a log-normal than a normal distribution.

Figure 4.1 gives the distribution of the WTP amounts for fishable (level C) water for questionnaire versions A, B, and C combined.[4] the distribution is

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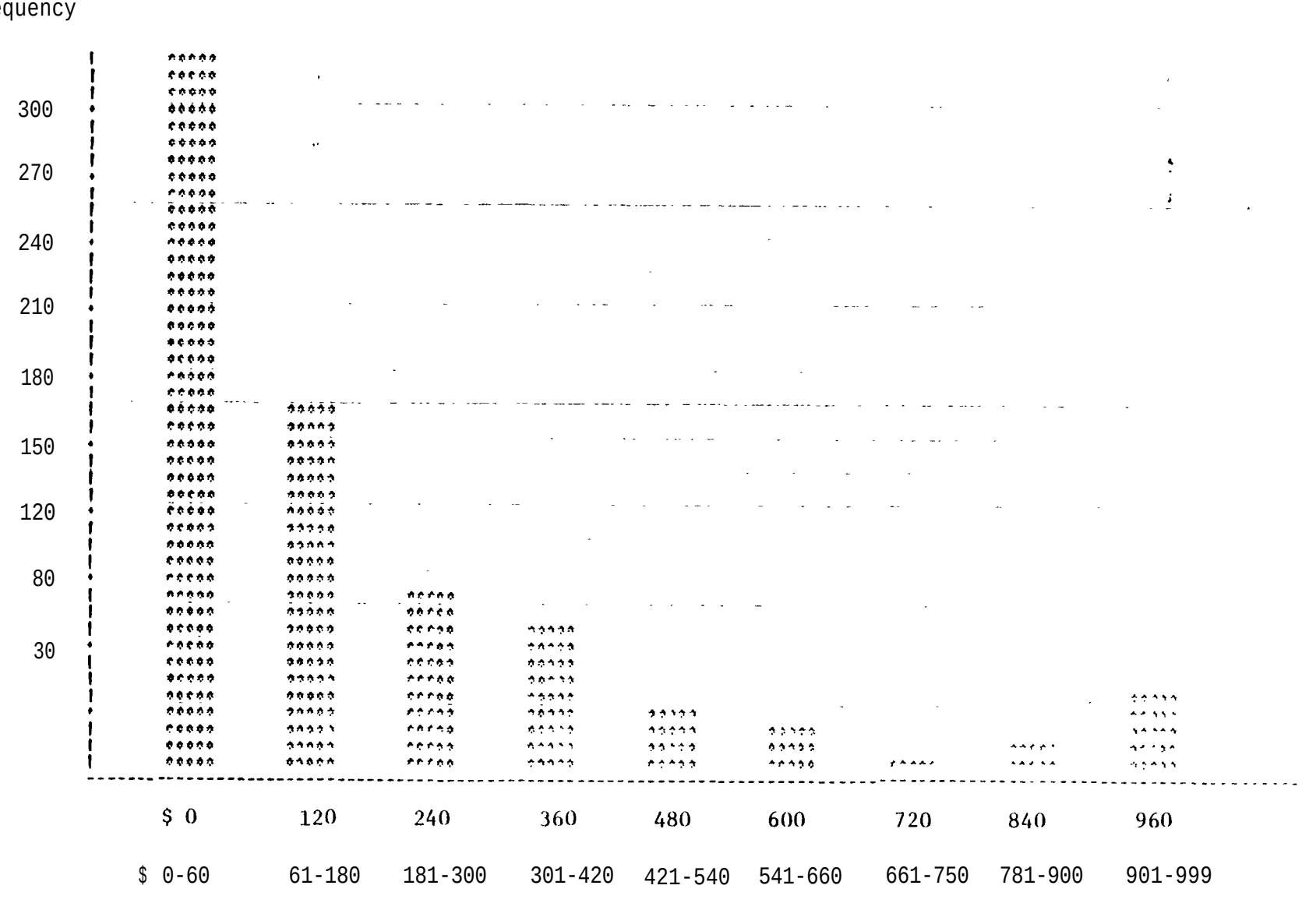
[3]According to O'Brien (1979:855) the log-normal distribution is somewhat more skewed than the distribution of income in the United States.

[4]Unless otherwise specified, we will normally combine the results for three versions, for reasons to be explained below. Whenever we report the results for one level, we will use C, fishable water. Unless otherwise specified, the results for the other levels (boatable, swimmable) parallel those for fishable.

Figure 4.1

DISTRIBUTION OF WTP AMOUNTS FOR FISHABLE WATER
FOR VERSIONS A, B, C COMBINED INCLUDING ZERO AMOUNTS



dominated by the WTP amounts in the lowest category, $0-60. Of these, more than half are zero bids. The high occurrence of zero bids is one of the two major problems with our method revealed by our experiment (the other being the relatively high percent of people who failed to give any WTP amount). It is a problem because it seems likely that most of those who gave zero bids actually have a greater than zero value for water quality and would be willing to pay some amount, however small, for water pollution control if we had an improved way of eliciting their true preferences. By probing zero responses, other studies have found that some of those who give zero WTP amounts do so to protest some aspect of the interview situation. This is undoubtedly the case in our situation, but we were

(continue)

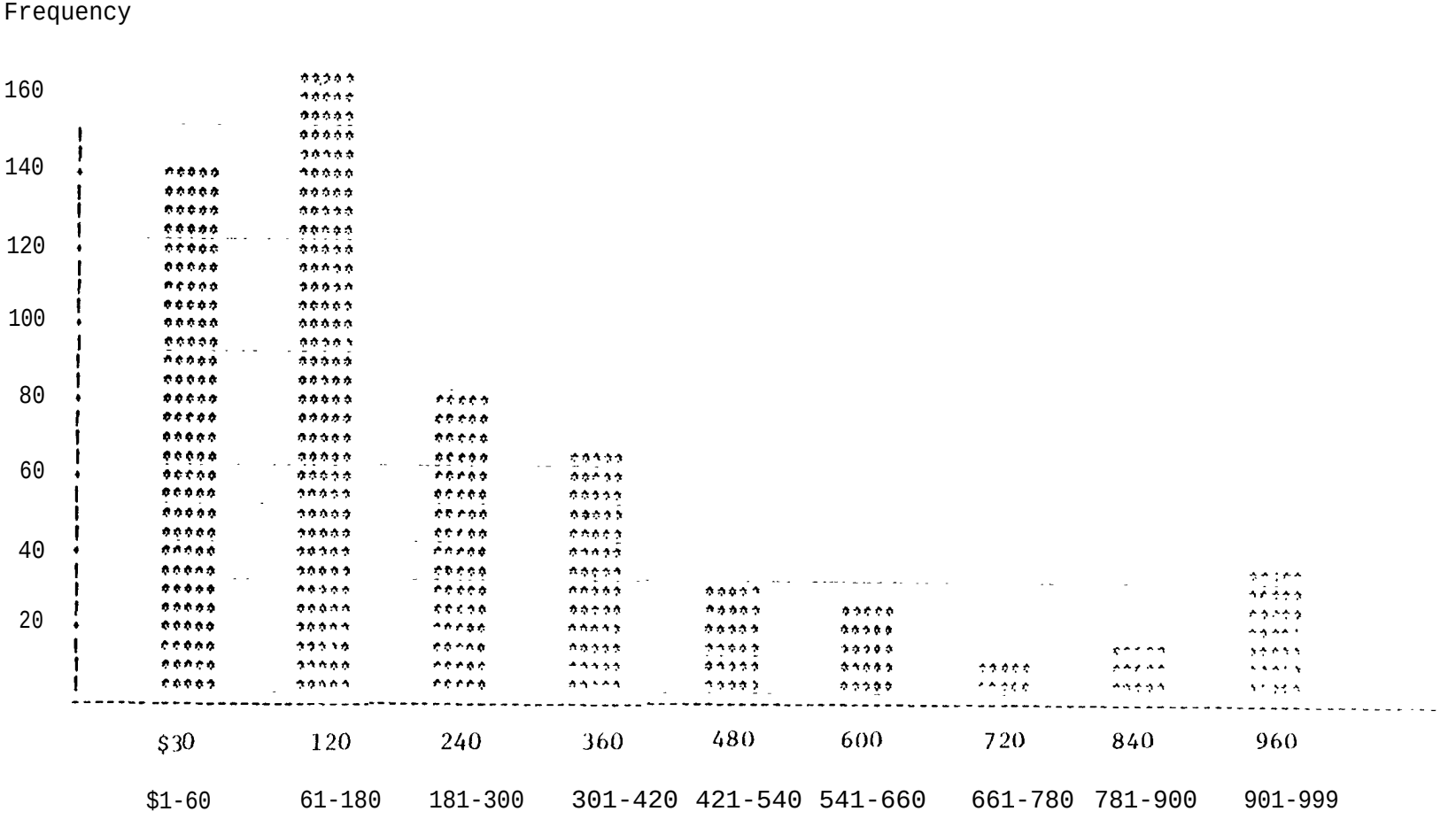
unable, for the reasons discussed in Chapter 3, to probe our zero bidders to learn the reasoning behind their amounts. (We discuss the problem of zero bidders in detail later in this chapter under item non-response bias.) Since we are unable to separate the "real" zero payers from the protest zero payers, our subsequent analysi includes all those who gave zero amounts. By doing this we bias our findings downwa by some indeterminate factor. However, for the sole purpose of examining the distribution of the WTP amounts, we recalculated the distribution leaving out all the zero amounts. The revised distribution is given in Figure 4.2.

1. At the upper end the distribution falls off until the highest category where it increases. This is caused in large part by the arbitrary $999 upper limit to our WTP amounts. Since most of those who gave this amount are in our highest income category, we believe that if the $999 constraint had not been introduced at the keypunching stage, the distribution would have tailed off gradually.

2. The overall shape of the distribution is not flat. It approximates a log normal distribution, a distribution similar to that reported by Brookshire, et al. (1976) in their Lake Powell study, and to the distribution of income in the United States. Since income is a strong predictor of people's willingness to pay for water quality, as we will see in Chapter 5, we conclude that the distribution does not suggest strategic bias.

Figure 4.2

DISTRIBUTION OF WTP AMOUNTS FOR FISHABLE WATER
FOR VERSIONS A, B, C COMBINED EXCLUDING ZERO AMOUNTS



A second method of testing the hypothesis that the distribtuion of WTP amounts will be "flatter" than normal when strategic bias is present is implied by Brookshire, et al. (1976) in their Lake Powell study when they make the following statements:

> ... false bids will be very large relative to the mean for environmentalists and zero for non-environmentalists where bids are constrained to be non-negative (1976:328).
>
> ... if strategic behavior had been prevalent one would expect a significant number of high bids relative to the mean bid (1976:340).

This test also has its problems. First, and most important, we have no objective way of identifying "false" values since the essence of the problem of preference revelation is that "true value is subjective and typically cannot be observed independently" (Freeman, 19796:97). Second, the simple fact that environmentalists are willing to pay more than other people for environmental goods (and non-environmentalists less) does not necessarily imply strategic behavior on their part, especially when the environmental good being valued is a broad one like the nation's water quality. If environmentalists are true to their professed ideals, we would expect them to be willing to pay more for water quality than those of comparable income who are less committed to environmentalist ideals.

Bearing these problems in mind, the best we can do is to arbitrarily define certain WTP amounts as inappropriately "high" or "low," relative to the respondents' income level, and see if a) the percentage of people who give bids of this kind is large enough to be troublesome and

b) if environmentalists and anti-environmentalists are disproportionately represented among those who give such bids in such a way that the results will be biased one way or the other.

Table 4. [2] divides those who gave us amounts for fishable water into four groups:

1. Those who gave zero.
2. Those who gave "low" amounts which we define as any amount above zero but equal to or lower than half the amount shown on the respondent's payment card as the amount contributed to the space program. For those in the lowest income group this is 1-6 dollars; for those in the highest this is 1-53 dollars.
3. Those who gave "high" amounts which we arbitrarily define as any amount equal to or greater than the amount shown for public education on their card. This amount was $204 for the low income group and S1695 for the high income group.
4. Those who gave an amount between the low and high extremes, who we label "normal."

Eighty-three percent of those who gave amounts greater than zero[5] fall into our "normal" category. Those in the extreme categories are divided, with 10 percent giving "high" amounts and 7 percent willing to pay low amounts. We conclude that those at the extremes are relatively few in number and rather evenly balanced.

The table also shows some of the characteristics of the people in each of these groups. Comparing those in the low category with the normals, the lows have a larger percentage of people in the highest income category

[5] Coding did not distinguish between zero and one dollar responses, which were both coded as zero (or, in log responses, as one).

Table 4.2

PERCENT OF THOSE GIVING VARIOUS LEVELS OF PAYMENT
WHO BELONG TO CERTAIN DEMOGRAPHIC AND ATTITUDINAL CATEGORIES

	Amount Willing to Pay for Fishable Water (level C)[1]				
	$0	"LOW"	"Normal"	"High"	Cave No Amount
Maximum N = [2]	(183)	(40)	(447)	(52)	(445)
A High Income[3]	13% (20)[4]	40% (16)	23%(101)	48% (25)	16% (57)
B Low Education:High School and Below	78 (143)	65 (26)	68 (275)	43 (22)	73 (328)
C Age 65 and Older	25 (46)	13 (5)	8 (38)	0 (0)	20 (92)
D High on Environmental Scale (2-4)	6 (10)	30 (11)	30 (144)	62 (35)	20 (88)
E Very Concerned About Water Pollution	30 (42)	43 (40)	41 (196)	65 (34)	38 (168)
F Use Water for Recreation	34 (62)	62 (25)	71 (334)	83 (43)	49 (220)

[1] "Low" amounts are defined as any amount equal to or lower than half the amount people of the respondents' income category were said to spend on space. "High" are amounts equal to or greater than the education amount given on the payment card. "Normal" are all amounts in between the low and high amounts.

[2] Total N varies for each of the demographic and attitudinal categories.

[3] Definitions of variables arc as follows: high income = 25t + / low education = high school or below/ high on environmental scale = score of 2-5 on a scale constructed from seven questions which varies From -5 to +5 ; See Appendix ___ for a Full description of the scale / water user = someone who has fished, boated or swam in last two years.

[4] Note that these percents are each independent of the rows and colums. Here, 13 percent of those who are willing to pay $0 have a "high" income.

($25,000 and above), and a lower percentage of users of freshwater for recreation. Overall, they are as environmentally concerned as the normals but are older, wealthier and somewhat less likely to use water for recreation. This combination of characteristics does not suggest upward-biased strategic behavior, although it is not inconsistent with free riding.

The highs are also higher in income than the normals. They are much more likely to be high on our environmental scale -- and in their concern about water pollution as a problem -- and somewhat higher in recreational water use (See Chapter 5 for a description of these measures). Although we would expect those who use and value water to place a higher value on it through their willingness to pay, and while half of the highs are in the highest income category and presumably can afford the amounts they said they are willing to pay, these data are consistent with the idea that some of these 52 people are overestimating their real willingness to pay. Whether this is the result of deliberate calculation (strategic bias) or unrealistic enthusiasm (hypothetical bias) cannot be determined. We do know they are more than balanced by the 183 zero bidders.

Hypothetic Bias

Hypothetic bias is the "potential error induced by not confronting the individual with the actual situation" (Schulze, et al., 1980). In a situation influenced by hypothetic bias people are so far removed from the actual situation that they do not have "genuine" opinions. Perhaps they are being asked about something which is so far removed from their experience and interests that they are indifferent to the public good. Alternatively, they may have sufficient interest or potential interest in the topic but the subject of inquiry is not specified in sufficient relevant detail in the instrument for them to have anything but superficial opinions. This is why social surveys sometimes find opinions about controversial topics shift dramatically according to the way contingencies associated with the issue are spelled out or specified.For example, attitudes towards nuclear power can be made to shift by 40 percentage points by varying the degree of assurance about nuclear safety in the working of the question (Mitchell. 1980:12).

Hypothetic bias may produce a variety of effects. One is greater uncertainty and ambivalence on the part of the repsondent compared with his or her response to a "more realistic" situation. The empirical consequence of this is increased variability in responses and/or a larger than normal number of refusals and don't knows. This uncertainty and ambivalence means that a respondent's WTP amounts are much more susceptible to the pressures of social desirability. In many cases (especially those involving substantial amounts) the direction of social desirability will be ambiguous or nonexistent. Below we explore the direction of hypothetic bias for this case.

The other primary effect is the rejection of some aspect of the hypothetical market in WTP surveys, The payment vehicle is usually the cause of this rejection which takes the form of refusals or protest zero amounts. This effect is more properly a separate component of the larger context correspondence problem we discuss later. Since this response is not due to availability to visualize the market.

Since WTP studies are by definition hypothetical, the avoidence of hypothetic bias requires ingenuity on the part of the researcher. It is the burden of our argument in this section that hypothetical or contingent markets can be described in such a way as to minimize hypothetic bias. We first discuss two preliminary topics which have not been much discussed in the literature: the direction of hypothetic bias and the relationship between strategic and hypothetic bias. We then treat the question of whether and under what circumstances survey research can realistically simulate markets for public goods, In the final part of this section we consider the extent to which our instrument suffers from context correspondence problems.

The Direction of the Bias

The WTP literature habitually refers to hypothetic "bias," but does not show what bias or systematic distortion of the WTP amounts is to be expected from unrealistic research instruments. Where people lack "genuine" opinions about a particular issue we would expect their responses to be more random than would be the case for an issue on which they held genuine opinions. In the former, more people will "guess" rather than "estimate." Such guesses are vulnerable to extraneous matters such as fatigue, personal attraction to the interviewer, exposure to the evening's news on television, etc. For this reason, WTP amounts affected by hypothetic bias will show greater statistical variance and less reliability than those not so affected. Combined with the constrained nature of WTP distributions, this greater variance will bias the WTP amounts upwards.

Let us consider this argument in greater detail. Given an initial (in our case the true) probability distribution with a known mean and variance, increasing the variance of that distribution may necessarily result in an increase in the mean (or expected) value of that probability function. This increase in E(x) can be shown to hold for many common probability distributions (the common characteristics of which appear to be a constraint on the ranges of values which the function can take). This constraint may be definitional or artificially imposed; in our case this constraint is the impossibility of negative values.[5a] Two probability

[5a] It should be noted that protest zeros must be removed before the distributional phenomenon described here can be observed.

distributions have been proposed for WTP distributions of our type: log-normal (Gramlich, 1977) and normal (Brookshire, et al., 1976).[6]

The log-normal distribution can be defined for x as $x = \exp(y)$ where $y = N(u,\sigma^2)$. The expected value of x is $E(x) = \exp(\mu + (1/2)\sigma^2)$ and the variance of x is $VAR(x) = \exp(2\mu + \sigma^2)(e^{\sigma 2} - 1)$. It can be straightforwardly observed that an increase in VAR(x) causes an increase in E(x).

The normal distribution is the other distribution which has been suggested as the appropriate distribution for WTP amounts. Because the mean and variance are independent from each other in the normal distribution, increasing the variance of the probability distribution does not change the mean. However in the case of WTP distributions we are not dealing with a true normal distribution, but a normal distribution which is artificially constrained[6a] to be non-negative. We shall call this distribution a constrained normal. Through a series of heuristic graphs we will show why the mean WTP value increases for this distribution when the variance of the initial probability distribution is increased.

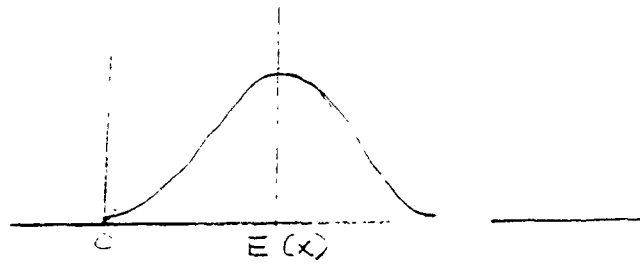
---

[6] The increase in the E(x) for an increase in the variance of the original chi square or F distribution follows directly from the inter-dependence of the mean and variance of a chi square or F variable. See Hogg & Craig (1978) or Freund and Walpole (1980) for a detailed discussion

[6a] In theory, nothing prevents a legitimate negative bid. Two examples of rational negative bids would be a person who feared clean water would bring hordes of tourists to his or her doorstep or the person who disliked environmentalists so much that the pleasure which clean water brought environmentalists caused him displeasure. In practice, however, no governmental authority would pay a citizen in order to provide him with clean water. We believe that the number of consumers whose true value for water quality is negative is sufficiently small so that we may consider the constraint of non-negative values to be inoperable. This is not necessarily true where the nature of hypothetical markets encourages a large increase in σ^2 relative to the true distribution.

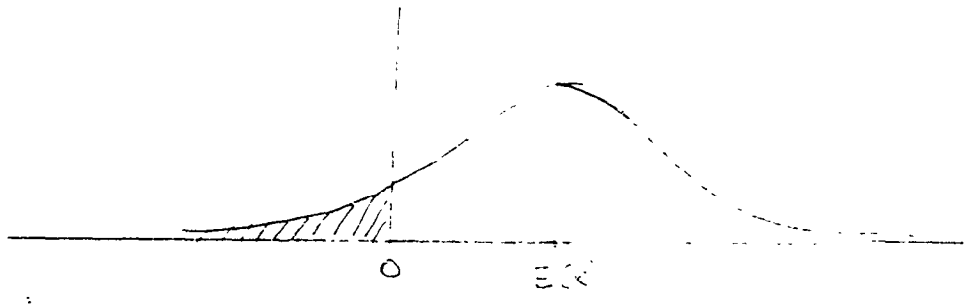
First consider the following graph of a true probability distribution:

Figure A



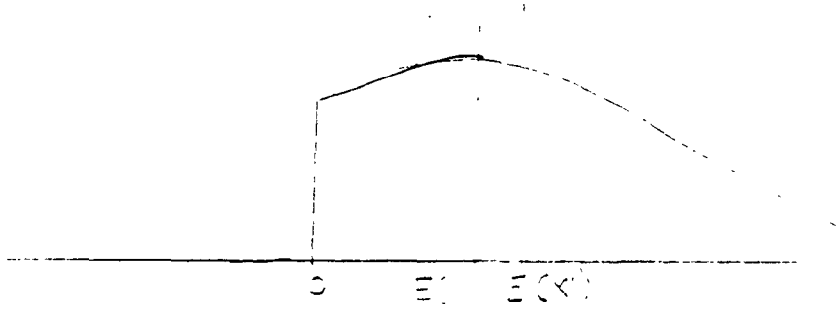
In Figure B below, we increase the variance of the original distribution. The mean of the new distribution is the same as the original and is indicated as E(x). The area shaded in to the left of zero is the area which will be truncated if the constraint is operable.

Figure B



Now suppose that the distribution is constrained at zero so that if $x < 0$ then $x = 0$. The truncated area of Figure 2 is rotated upward to the right side of the zero axis and the resulting distribution is shown in Figure C. In this Figure E(x) is the expected value of the original distribution and E(x') is the expected value of the constrained normal distribution. In terms of the definition of the sample mean of a normal variable? = $(\Sigma x_i/n)$ some of the x_i's are greater than they would have been in the unconstrained distribution causing $\bar{X}' > \bar{X}$.[7]

Figure C



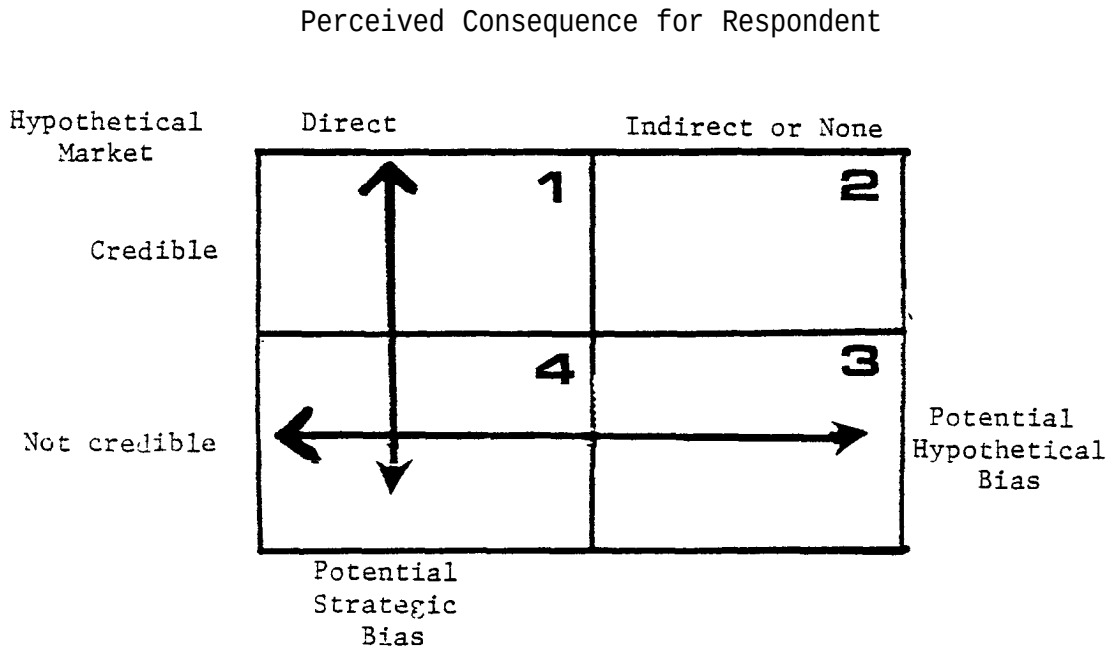
[7] In a more severe case than our constrained normal distribution -- that of a truncated normal distribution where the truncated observations are discarded -- Cohen (1950, 1967) has shown that the sample mean of the resulting distribution is dependent upon the variance. As an example, if a normal distribution with mean zero and variance σ^2 is truncated at zero and all negative observations are discarded the resulting sample mean is $\bar{X}' = \sqrt{\frac{2}{\pi}}$ which must be greater than zero unless $\sigma = 0$.

The Relationship Between Strategic and Hypothetical Bias

A second important aspect of hypothetical bias which is unresolved in the literature is the nature of its relationship with strategic bias. When statements are made that: "The hypothetical nature of such (WTP) surveys may then, in actuality, aid in eliciting bids which are not strategically biased" (Schulze, et al., 1980:11) the implication is that hypothetical bias is the opposite of strategic bias. According to this logic,strategic bias occurs because people believe the situation is "real" and cover up their "genuine" opinions to suit their perceived interests whereas it is the unreality of the situation which promotes hypothetical bias. We believe it is more correct to distinguish strategic from hypothetical bias in terms of the types of realism involved, however. Strategic bias is promoted when the consequences of the WTP questions are perceived by the respondent as real. Hypothetical bias, in contrast, is induced when the market described to the respondent is not realistic enough. These two factors may vary independently as shown in Table 4.3. Respondents may perceive that they either will have to pay the amount they state for

(continue)

Table 4.3 TYPES OF REALISM AND STRATEGIC AND HYPOTHETIC BIAS



the public good or that their responses will directly influence public policy. On the table this is described as a direct consequence and promotes strategic bias. Alternatively this consequence may not seem likely to them, a perception which appears to be the general rule among respondents in WTP studies including this one. Turning to the other dimension, hypothetic bias is minimized when the hypothetical market is credible or plausible to respondents in that it accords sufficiently with their understanding of how the world works and imposes realistic (albeit hypothetical) constraints on preferences (by introducing cost, for example). It is the absence of this market realism which promotes hypothetical bias. Both biases are minimized, therefore, when consequence realism is low and market realism is high (cell 2 in the Table 4.3).

Schulze, et al., in a discussion of hypothetic bias argue that both consequence and market realism are necessary for WTP surveys (cell 1):

> "The contingent valuation approach requires postulating a change in environmental attributes such that it is believable to the individual and accurately depicts a potential change. The change must be fully understandable to him, i.e., he must be able to understand most, if not all, of its ramifications. The individual also must believe that the change might occur and that his contingent valuation or behavioral changes will affect both the possibility and magnitude of change in the environmental attribute or quality. If these conditions are not fulfilled, the hypothetical nature of contingent valuation approaches will make their application utterly useless." (Schulze, et al,, 1980:14).

We agree with the first part of their statement, but not the second part. We do not believe, as they apparently do, that consequence realism is necessary for a credible survey. Certainly none of the WTP surveys reported in the literature on air and water pollution have achieved it, a judgment in which Schulze and his colleagues concur; and if they had, strategic bias would become a genuine problem for WTP surveys. In what follows we argue that properly designed surveys can describe situations with sufficient realism to elicit meaningful responses and discuss the adequacy of our questionnaire in this regard. We then propose theoretically based regression estimations as an appropriate test for hypothetical bias.

Survey Research and Market Simulation

According to Randall, et al. (1974:135) the validity of WTP surveys "depends on the reliability with which stated hypothetical behavior is converted to action, should the hypothetical situation posted in the game arise in actuality." The challenge is to create a believable and meaningful set of questions which will simulate a market for the public good in question, Some would argue that this is an impossible task, that survey research is too removed from reality to be able to predict behavior. This view seems to lie behind the remarks of Gary Fromm that "It is well known that surveys that ask hypothetical questions rarely enjoy accurate responses" (Fromm, :172).

In fact, as Howard Schuman and Michael Johnson (1976) show in their major literature review of the relationship between attitudes and behavior, most studies which measure people's attitudes and their subsequent behavior show positive results. At the individual level, for example, those Army trainees who say they are eager for combat are significantly more likely to perform well in combat several months later (Stouffer, et al., 1949) and persons who say they support open housing are far more likely (70%) to sign an open housing petition three months later than those who expressed opposition to open housing (22%) (Brannon, et al., 1973). One study of four elections showed behavioral intention predicted correctly to actual vote for 83 percent of the respondents who voted (Kelley and Mirer, 1974). Schuman and Johnson cite numerous other examples of attitude behavior correlations and conclude that the attitude-subsequent behavior correlations which occur "are large enough to indicate that important causal forces are involved" (Schuman and Johnson, 1976:199) although the variance explained by attitudinal intention is usually fairly modest.

The most impressive demonstrations of attitude-behavior correlations occur at the aggregate level. Modern election polls predict election results with great accuracy. The 1980 presidential election was no exception to this generalization because the polls which took place immediately before the vote caught the last minute shift which brought President Reagan to power (Ladd and Ferree, 1981). For many years the Institute for Social Research at the University of Michigan has used

survey research to measure consumer sentiments and probe the psychology of economic behavior. Their Index of Consumer Sentiment represents a macro measure reflect&g the changes in attitudes and expectations of all Americans. For the past 25 years it has declined substantially prior to the onset of every recession and it advanced prior to the beginnings of periods of economic recovery (Katona with Morgan, 1980). These correlations occur despite the fact that the University of Michigan economists are unable to predict an individual's spending or saving on the basis of changes in his or her attitudes and expectations. They attribute this paradox to fact that individual consumer behavior is influenced by a large number of factors including situational, attitudinal, and physical (fatigue) which make accurate predictions of individual behavior difficult to make. The volatility of individual behavior is smoothed out for aggregations of people; mood, individual differences in how people react to the particular stage in the business cycle, individual reactions to whether or not they have recently purchased large consumer durables and the like are averaged across the sample (Katona with Morgan, 1980:60). This is a strong argument for the validity of surveys (provided the questions are well worded and the sampling is adequate) as measures of aggregate benefits.

We conclude that properly designed survey questions do have the potential to ap proximate real situations sufficiently to elicit "responsible" responses which can be predictive of behavior under the defined circumstances contained in the questions (Brookshire, et al., 1979:30-31). Schuman and Johnson analyze the design factors which improve behavioral predictions, One of the most important is the degree of congruence between the expressed attitude and behavior. Heberlein and Black (1976), for example, found

(continue)

attitude-behavior correlations increased from .12 to .59 for the use of lead-free gasoline when the predictive attitudes shifted from general interest in environmental issues to a question about the degree of personal obligation the respondent felt to buy lead-free gasoline. In a similar vein, Brookshire, d'Arge and Schulze cite the psychologists' Ajzen and Fishbein's well known dictum that behavioral intention and the actual behavior "should correspond, in terms of the action, its context, its target and its time frame" (Brookshire, et al., 1979:25).

A second important design factor is the degree of information presented about the consequences of an attitude, particularly its financial implications. The more fully these consequences are specified, the more realistic the response. In the 1960s Gallup consistently found a majority of people favored foreign aid when they were asked: "In general, how do you feel about foreign aid -- are you for it, or against it?" In a national survey during the same time period, Lloyd Free and Hadley Cantril introduced the pocketbook aspect of the issue in a question which asked whether "government spending for this purpose (foreign aid) should be kept at least at the present level, or reduced, or ended altogether?" When costs were raised in this manner the majority position shifted from favoring foreign aid to wanting it reduced or ended (Free and Cantril,1967:72;/ see also Mueller, 1963). A similar shift occurred in a poll conducted in the Swedish city of Malmö. In this case a sample was asked whether they would like the Swedish government to increase aid to less-developed nations. Later, in the same questionnaire, the respondents were asked whether they would like this to take place "even if taxes would be raised in proportion." Half the supporters of increased aid vanished when the question was phrased this way, leaving only 20 percent who were willing to pay for increased aid (Bohm, 1979:146).

The shifts in opinion evoked by the changes in question wording are understandable because we would expect higher demand for free goods according to economic theory, The Swedes who favor foreign aid in the first question consist of two types of people: 1) those who favor it in the abstract but who are not willing to pay for it when reminded of that contingency and 2) those who favor it in the abstract and who are also willing to pay for it, The second question induces those in category 2) above to relinquish their support by introducing the contingency of cost. WTP studies go one step further, of course, and ask respondents to specify the amount of money they personally are willing to pay, This and the fact that many other contingencies are spelled out in the questionnaire makes them a far more realistic measure of attitudes than ordinary survey research items.

Context Correspondence

As we noted in Chapter 2, there are special challenges in devising a macro WTP instrument which is sufficiently realistic to avoid hypothetical bias, We made special efforts, as described in Chapter 3, to present the market for national water quality in terms that are understandable to the respondent and which related as closely as possible to the way the respondent actually contributes to the provision of water quality. We will not repeat that discussion here, but will amplify it by discussing the degree to which our instrument is threatened by context correspondence problems, a particular form of hypothetic bias.[7]

As described by Brookshire, et al. (1979, 26ff), these problems occur "where the initial rights and endowments as well as the terminal rights and endowments are far removed from the actual situation." The primary example of the context correspondence problem is the failure of questions using the willingness to accept compensation format to elicit meaningful answers. The notion of being "bribed" to tolerate pollution is so far out of people's ordinary comprehension that many people apparently consider it immoral and refuse to value the environmental good at anything less than infinity (Randall, et al., 1974; Blank, et al., 1977: Brookshire, et. al., 1980 and above in Chapter 1). Is is possible that the high percent of no-plays and zero bidders we found is an indicator that our instrument suffers from context correspondence problems?

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[7] Brookshire, et al., say a high percentage of protest votes is an indicator of context correspondence problems (1979:28)

On an a priori basis we do not believe this to be the case. The initial endowment of boatable water nationally and the notion that people are paying for water quality of this level in taxes and higher prices seems well within people's understanding, particularly since they are already paying for water quality in this manner (although they may not have thought about it), Our instrument assumes a structure of rights in which fresh water is a common property resource which can be used for various purposes, The simulated market provides a situation in which the individual can buy improved water quality situations by paying higher taxes and prices.[8] It assumes that these cannot be provided free of charge. It is possible that some people may feel that businesses should pay the costs of treating pollution out of profits instead of passing the costs on to consumers, but surveys suggest that a large majority of the public are aware of the fact that these costs do get passed on to consumers (Cambridge Reports, 1978:167).[9] Finally, the improved situations we propose, fishable and swimmable water, do not appear to be so far from the initial position (boatable water nationally) to cause problems nor to deviate dramatically from the person's previous experience and preferences. Most people will have had first hand contact with freshwater of those quality levels.

However, when we ask people to put a dollar value on water quality levels we are asking them to do something that is not part of their normal

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[8] In the case of going from boatable to non-boatable the respondents were buying the continuance of the status quo. See the more detailed discussion of property rights in Chapter 1 where we specify the types of consumer surplus measures we employ in this study.

[9] Cambridge Reports in a report for the Shell Oil Company asked a national sample: "When the government imposes new health or safety standards on an industry which single group do you think usually pays the cost of implementing those standards: the industry out of its profits, workers in the industry through lower wages, consumers through higher prices or the government using tax money? Sixty-two percent said consumers through higher prices (Cambridge Reports 1978:167) and 12 percent "the government using tax money." Only 7%

behavioral repertoire; both the valuing and the contemplation of national water quality are novel experiences for most people, By way of contrast, those WTP studies which ask people to place a value on certain characteristics of a particular recreational site in terms of an entrance fee ask people to perform a much less novel act since people are familiar with entrance fees and regularly make decisions about whether or not they are worth the price. Does this mean that such a study is necessarily more valid than ours? We think not,because familiarity may present problems of its own. When respondents are asked to express WTP amounts by the entrance fee vehicle (e.g. Thayer, forthcoming) the amount they give may represent not what they personally consider the benefit to be worth but what they consider to be a "fair" entrance fee based on their experience with entrance fees, Thus, novelty as such need not be an impediment. What matters most is whether respondents are made sufficiently familiar with the new situation in the interview.

Where context correspondence is present we will expect two outcomes. The first is a greater incidence of item nonresponse for the WTP items. More people will be unable to find the situation meaningful enough to offer WTP amounts or in protest they will bid $0. WTP surveys test for context correspondence by examining (and reporting) the rates of these responses. As noted earlier we had large numbers of people who failed to give amounts or who gave $0 amounts. In our discussion of this problem below, under item nonresponse bias, we conclude that it is probably caused by problems other than context correspondence.

Secondly, if the situation which respondents are valuing is too removed from the experience or interests, their answers to the WTP questions will be more whimsical than purposeful and should vary randomly. Conversely, if the task is meaningful to the respondent, his or her answers will be constrained by the factors which influence decisions about such expenditures in everyday life: income and value. The context correspondence problem in this instance is increased/ variability. An appropriate test for randomness of responses is the size of R^2 in a regression of WTP amount on theoretically-based constraints[10] (in our case: recreational use of freshwater, concern about water pollution, income, etc.). We report the results of our predictive test in Chapter 5. Our findings in this respect are very reassuring.

INSTRUMENT BIASES

The willingness to pay literature has identified four instrument characteristics which are potential sources of bias, These are the payment vehicle, information, order and starting- point biases. A number of studies have varied these dimensions systematically in an effort to see whether or not a particular instrument bias is present. Our effort in this regard was limited to the most innovative aspect of our instrument; the use of the payment card to elicit the respondents WTP amount. The results of this experiment are discussed in detail under starting point bias. The instrument was designed to minimize the effect of each of the other potential biases.

Starting Point Bias

In Chapter 3 we discuss why we believe starting point bias is a serious problem for bidding game studies which use payment vehicles other

[10] For an excellent example, see Brookshire, et al., 1980.

than admission fees to measure people's willingness to pay for public goods. We developed the anchored payment card as a substitute for the opening bid on the assumption that presentation of a large menu of potential bids would minimize any tendency on the respondent's part to acquiescece to the interviewer's suggested bid. There is the possibility of course, that the payment card itself might bias the WTP amounts. To examine this possibility we manipulated the two aspects of our payment cards which seemed to present the greatest possibility of influencing respondent WTP amounts and tested several different versions of the payment card on comparable sub-samples. These variations and the rationale behind them are as follows:

1. The payment card is anchored with estimates for non-environmental goods. We varied the number of goods presented from four in versions A and C to five in Version B.[11] The extra good in Version B was police and fire protection, The amount which we estimated households spent on this good ($98, $125, $312 and $626 for the four income levels[12]) was such that it placed police and fire protection on the payment card at a place where we guessed people might value water quality. Except for the addition of the fifth

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[11] In this discussion we will only consider versions A, B, C, of our instrument. Version D was significantly different and our findings for this version will be described elsewhere. See Chapter 3 for a description of the research instrument and Appendix I for the complete wording of all the questions.

[12] See Appendix III for the procedures used to derive the public good expenditures and Appendix I for all the payment cards used in the study.

public good, the payment cards for Version B are identical to those for Version A. If the number or placement of the anchors affects the starting point we would expect the mean WTP amounts for B to differ from the amounts for the other versions.

2. In order to see whether people keyed their water benefit amounts to the amounts shown on their card for the other public goods, Version C displayed the same four public goods as Version A, but each amount was increased by 25 percent. If the dollar level of the anchor or benchmark goods determines the WTP amounts for water quality we would expect higher mean amounts for Version C than for Version A.

Table 4.4 summarizes the sample design for our tests of starting point bias. We used t tests to test for the hypotheses:

Test I H_o: $A = C$

H_1: $A < C$

Test II H_o: $A = B = C$

H_1: $A \neq B, A \neq C, B \neq C$

Where A, B, C refers to versions A, B, C.

Table 4.4

STUDY DESIGN FOR EPA WATER POLLUTION BENEFITS STUDY
AND NUMBER OF CASES (IN PARENTHESIS)

	Versions	*Family Income Levels*	*Water Quality Levels*
			Amount willing to pay for:
A	Scale cards with the estimated levels of payment for space, highways, public education and defense for each of the four income categories. (431)*	I $9,999 or less (117) II $10,000 to 14,999 (58) III $15,000 to 24,999 (112) IV $25,000 and above or not sure/refused (92)	D Okay for boating (2.5 on 10 step ladder) C Game fish like bass can live in it (5.0) B Safe for swimming (7.0)
B	Scale cards with correct payment levels for the four public goods used for A plus police and fire (380)	Same as A I (170) II (66) III (98) IV (62)	Same as A
C	Scale cards with same four public goods used for A but the payment levels listed are 25% higher than those used for Version A (410)	Same as A I (116) II (58) III (126) IV (74)	Same as A
D	Same as A plus the estimated amount for water pollution control (355)	Same as A I (82) II (78) III (103) IV (70)	Asked whether willing to pay the specific amount for level C If not willing to pay, asked how much willing to keep level at D If willing to pay for C, asked how much willing to pay for B

"The total number of cases for each version exceeds the sum of the number of cases ascribed to each income level for that version owing to the absence of income data for some respondents.

The results of these tests for each income by water quality level category are given in Table 4.5. Of the 24 paired comparisons only two are significantly different from zero (less than the number positive findings one would expect by chance at the .05 level) and both are in the opposite direction to that predicted if starting point bias is present. We conclude that for I and II, the null hypothesis is supported: there is no evidence of starting point bias.

A second test of starting point bias was conducted using regression analysis. We made dummy variables for each of the three versions. We then estimated two sets of equations for pairs of versions. The first used one of the dummy variables as the sole predictor variable, the second is identical to the first except that we added the set of predictor variables which are the best predictors of the WTP amounts. If H_o in Test II is incorrect, the dummy variables for the versions should enter the equations significantly (as measured by the t values). Table 4.6 presents the results of these estimations. None of the version dummy variables are significant, confirming our finding above that our instrument does not suffer from starting point bias.

On the basis of these findings, which not only show no version effect but also reveal an impressive stability across the versions in the multivariate estimations, we combine the three versions into one data set for all further analysis.

Table 4.5 t TESTS OF MEANS[1] FOR PAIRED COMPARISONS BETWEEN VERSIONS A, B, C BY INCOME AND LEVEL OF WATER QUALITY

		Level of Water Quality								
		Boatable			*Fishable*			*Swimmable*		
Income Level										
Low	1	AB	AC	BC	AB	AC	BC	AS	AC	BC
	2	AB	AC	BC	AB	AC*	BC	AB	AC	BC
	3	AB	AC	BC	AB	AC	BC	AB	AC	BC
High	4	AB	AC	BC	AB	AC	BC	AB	AC	BC

[1] Two tailed test, variances between samples were compared and then the t test was computed on pooled or separate variables as appropriate.

The one tailed t-test was insignificant for every pair of A and C for test I since the two significant pairs of A and C (* in the table) under the two tailed t tests are in the opposite direction from that predicted by H_1 of test I.

*Difference between the means is significantly different from 0 at the 5% level.

Table 4.6

TEST FOR STARTING POINT BIAS

Variables

Level C	Amount willing to pay annually for fishable water in dollars
VERA	Dummy variable for Version A
VERB	Dummy variable for Version B
VERC	Dummy variable for Version C
INCOMER	Household income in dollars in 10 categories
EDUC	Education in 7 categories
AGECAT	Age in 11 categories
ENVINDEX	Index of environmental attitudes*
USERD	Dummy variable for water use
CNPOLD	Dummy variable for concern over water pollution

Regressions on Level C for Versions A, B, C as Noted:

	A & B	A & C	B & C
Intercept	179.44 (10.7)	190.6 (10.8)	190.6 (11.5)
VERA	32.4 (1.4)	21.4 (.9)	
VERB			11.1 (-.5)
N	515	500	481
R^2	.003	.002	.001
F	1.9	.79	.24
INCOMER	.0072 (8.95)	.0069 (8.4)	.0073 (9.3)
EDUC	16.8 (1.85)	13.9 (1.4)	15.1 (1.78)
AGECAT	-10.5 (-2.88)	-8.7 (-2.3)	-8.4 (-2.5)
ENVINDEX	26.06 (3.81)	29.8 (4.3)	30.9 (5.2)
USERD	54.41 (2.33)	40.9 (1.74)	27.46 (1.3)
CNPOLD	44.47 (1.95)	48.3 (2.1)	64.8 (3.2)
VERA	21.58 (1.03)	12.22 (.58)	
VERB			-12.7 (-.67)
N	472	467	451
R^2	.30	.29	.34
F	37.9	27.3	32.4

t values are given in parenthesis

*Composed of 7 items ranging from attitudes towards the environmental movement to the importance of environmental problems in the respondents hierarchy of issues.

Payment Vehicle Bias

In Chapter 3 we describe why we chose annual household payment in higher prices and taxes for our payment vehicle. There we argue: 1) that our vehicle realistically accords with the actual form of payment for water quality and 2) that it is familiar to respondents yet lacks the drawbacks posed by some familiar vehicles such as entrance fees which may limit WTP responses to an accustomed payment range rather than to a true WTP amount. A further criteria for payment vehicles imposed by economic theory is that they should offer respondents the widest possible latitude of potential substitution across current commodities (Schulze, et al., 1980:12). We believe our vehicle combines believability with the widest latitude for substitution, two characteristics which often must be traded off in WTP surveys (Brookshire, et al., 1979:23-4). In the administration of the survey we encountered no problems with the vehicle. If the vehicle suffers from any bias it is likely to be downward owing to the current national concern over taxes and prices.

Information Bias

Information bias occurs when the wording of the instrument affects the values elicited in ways unintended by the researcher. The result is the introduction of contingencies other than those contained in the formal hypothetical situation. Because the opportunities for information bias in questions are legion, the evaluation of a WTP study must include a review of the wording of the entire instrument and an examination of the quesiton. In Chapter 3 we introduce and describe the questions we

used in this study. Needless to say, we attempted to word the instrument in such a way that by spelling out the tradeoffs, the cost, the fact that they are already paying for public goods, etc. the respondents were presented with a credible hypothetical market for water value. We endeavored to word the instrument in as neutral a manner as possible so that neither the costs nor the benefits of water quality were emphasized at the expense of the other. Readers can judge the success of our efforts for themselves by consulting Appendix I which contains the entire instrument in the form it was given to the interviewers.

Order Bias

Order bias is closely related to information bias. Some information may influence people's responses in an unwelcome manner simply because of its location in the questionnaire. The little research that has been done on order effects suggests that this is not an important source of bias in surveys (Alwin, 1977:141), but good survey practice dictates that sensitive or potentially biasing items should be located later in a questionnaire, otherwise the sensitive items might lead respondents to prematurely terminate the interview and the biasing items might affect the answers to questions which are sensitive to that type of bias. In WTP surveys it is important to avoid preceding the WTP items with questions which emphasize the benefits of the good being valued at the expense of the cost or vice versa. Rowe, et al. (1979:6) specifically cite the possible influences of early environmental attitude questions in this regard.

The RFF water benefits was preceded by a half hour (or more) interview on environmental and energy issues. The questionnaire for this study is contained-in Appendix IV. What bias, if any might result from the respondent being subjected to a searching interview about environmental protection, environmental values, risk, energy source preferences, and government action on these matters? Yore particularly, might these questions stimulate a greater value for environmental quality than would otherwise have been the case and bias the WTP amount upwards? We think this is unlikely for the following reasons:

1. The earlier questions were realistic and balanced because they measured environmental values in the context of the tradeoffs associated with obtaining better environmental quality. They a) forced people to rank order environmental goals with other goals (Qs. 1-10), b) elicited people's views about economic and energy problems (Qs. 11a, b, f; 21a, f; 26; 40-46) and c) used questions whenever possible which described the tradeoffs entailed in minimizing risk or protecting the environment (e.g., Qs. 31, 34-36, 39, 53c).
2. A contributing factor to the realism of the RFF environmental survey is the unique historical context of the survey. Most of the interviewing occurred in late January and early February 1980, a time when the Iranian hostage crisis and the Russian invasion of Afghanistan were dominating the news. These concerns, added to the great concern expressed by our respondents about

inflation and higher prices, suggest the historical context did not bias the respondents towards taking an environmentally oriented position. If anything, the opposite is likely to be the case.

3. It is possible to compare the degree of environmental support revealed in the RFF questionnaire with the findings of a commercial phone survey (Opinion Research Corporation, 1980) which took place two months after most of the RFF interviewing and which repeated several key questions word for word. The commercial survey found even stronger support for environmental values than did the RFF survey. This suggests that the format of the RFF survey did not bias people towards viewing the environment with special favor, but rather it seems to have led people to evaluate the issues with greater realism.

In our judgment the earlier environmental/energy questions add to the validity of the WTP study by requiring the respondents to consider a wide range of environmental issues and their tradeoffs prior to evaluating the worth of water quality. It is possible, however, that the length of the first portion of the survey may have induced respondent and interviewer fatigue. If we had used the bidding game format fatigue, if present, might have biased the WTP results upwards by tempting respondents to acquiesce to the starting point more often than would otherwise have been the case. (or downwards by making their willingness to pay bid lower). Since the payment card technique minimizes starting point bias, we have no reason to believe that fatigue biased our results upwards in this manner. On the contrary, fatigue may be a cause of the large number of zero amounts and no answers which we experienced.

SAMPLING BIASES

There is a set of potential biases associated with the methodology of survey research which have received less emphasis in the WTP literature than they should. An instrument may be entirely free from general and instrument biases, but if it suffers from serious sample and non-response problems its findings cannot be generalized reliably to a larger population of any kind and should not be used to estimate aggregate benefits. In the past some WTP studies have made such aggregate benefit estimates on the basis of seriously flawed samples or, worse, without even reporting the information necesary to assess whether method biases are present or not.

Sample Bias

Scientific sampling is a process by which elements of a population are chosen in such a way that information about those elements can be generalized within known error ranges to the population from which the elements are drawn. Methods of sampling are well grounded in statistical and probability theory. There are numerous sampling techniques but the distinguishing characteristics of a properly designed sample are that all the units in the target population have a known, nonzero chance of being included in the sample, and the sample design is described in sufficient detail to permit reasonably accurate calculation of sampling errors.[13] Sampling bias occurs when samples are not properly designed or reported.

[13] For a presentation of sampling theory and design for the non-technical reader see Williams (1978). For a discussion of sampling for surveys see Babbie (1973:73-130) and, especially Sudman's excellent book, Applied Sampling (1976).

The sampling method used for the RFF survey is a probability sample, the more rigorous of the two sampling methods regularly used by commercial survey research firms (the other being the modified probability sample). A description of the sample, which was designed by the Roper Organization, is presented in Appendix V. It ensures that all noninstitutionalized persons, 18 years of age or older, who live in the lower 48 states have a known probability of being interviewed.

There are many considerations which enter into the decision about how many people to interview for a study,but the basic tradeoff is between cost and accuracy, Presuming that the respondents are selected according to sampling theory, the smaller the size of a set of respondents (which may range from the entire sample to a sub-sample of special interest to the analyst such as environmental activists), the larger the sampling error. For a simple random sample, the error range at the .05 level of confidence is 3 percent for 1,067 respondents and 7 percent for 196 (Backstrom and Hursh, 1963:33). For a sample of 50, the Opinion Research Corporation estimates a 14% sampling error. Thus, if 25 percent of a sample of 50 say they went boating at least once in the past two years, the true value will lie between 11 and 39 percent, 95 percent of the time. Obviously, if these 50 people were not chosen by proper sampling techniques the error range is unknown,and it is impossible to say anything about what percent of any larger population (such as the people who live in the area where the interviewing took place) went boating in the last two years. For this reason, a true[14] sample of 1500 people allows Gallup to predict

[14] We use "true" here to refer to a probability based sample,

a national election with great accuracy whereas a non-true sample of 100,000 is worthless for this purpose as the Literary Guild Magazine learned to its chagrin when it predicted Landon over Franklin Roosevelt. The RFF survey results are based on a total sample size of 1576. Much of the analysis in this report is based on versions A, B, and C for (N=1221) for wh we have approximately 700 valid answers to our WTP questions.

Response Rate

The results of a sample survey can be biased if a "significant" number of people selected to be part of the sample refuse to be interviewed or are unavailable to the interviewer because of travel, sickness or work at the time the interviewer calls. When this occurs, bias is introduced because those not interviewed are likely to differ from those who were interviewed in systematic ways. For example, they may be more or less environmentally oriented. The question of what constitutes a significant number does not have a simple answer owing to variations in sampling design (some call for substitutions on a prespecified basis where the person sampled is not available at the time of the interview), in interview method (rates differ for the telephone, mail and personal interview techniques), and in the method of calculating the response rate (since non-responses can be due to outright refusals, to not being at home, to terminating the interview before it is completed, etc. the way of calculating the rate varies according to what is defined as a non-response) (Dillman, 1978:49-52).

When there are no established criteria for determining the quality of the response rate, as is the case for most surveys which are not conducted by professional survey research organizations, researchers should provide sufficient information to enable the reader to evaluate the sampling implementation.[15] In our case, we used a professional organization and well established sampling procedures. The response rate for our survey is 73 percent, computed upon the number of interviews completed in households containing people eligible for an interview. Those not interviewed included people who refused and those who were not at home even after the interviewers made up to three call backs to reach the person in the household designated to be interviewed by the sampling plan. This response rate is well within current national sample survey practice using this methodology.[16] A comparison between the RFF sample and census data for age, education, income, sex, race and region shows the RFF sample to be a close approximation of the nation on all but education and those with the highest income (Table 4.7). Those with a less than high school education and the highest income are somewhat under represented , a common occurrence in sample surveys as these people are among those most likely to unavailable (the rich travel or are less accessible; those with low educations are disproportionately

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[15] The Colorado State researchers, for example, describe their samples in admirable detail (Walsh, et al., 1978:19-23) and include a table which informs the reader that of 600 people originally selected for interview, 48 letters were returned, 231 could not be contacted by phone, 119 refused to be interviewed when contacted and 202 were interviewed.

[16] Although it is impossible to make a direct comparison, our 73 percent may be compared to the 37% rate achieved by the Colorado State researchers (excluding the returned letters, but including in the base those the interviewers could not reach and those who refused?.

Table 4.7

DISTRIBUTING OF RESOURCES FOR THE FUTURE SURVEY
ON KEY DEMOGRAPHIC VARIABLES

	RFF	Census*
Age		
18 - 24	16%	18%
25 - 34	26	22
35 - 44	15	16
45 - 54	14	15
55 - 64	15	13
65 +	15	I.6
	100	100
Education		
	(age 18+)	(age 25+)
Less than High school	25	32
High School	38	37
some college	20	1.5
college	17	16
	100	100
Income		
Under $9,999	25	24
$10 - 14,999	16	17
15 - 24,999	28	31
25 +	22	28
refused	10	-
	1.01	100

	RFF	Census
Sex		
Male	47%	48.7%
Female	53	51.3
	100	100.0
Race		
Black	12	12
White	87	88
	99	100
Region		
New England	7	6
Mid Atlantic	17	17
East North Central	17	19
West North Central	9	8
South Atlantic	17	16
East South Central	6	6
West South Central	9	10
Mountain	5	5
Pacific	14	14
	101	101

*Current Population Reports (Population characteristics: Profile or the United States: 1979) Series P-20, No. 350, U.S. Department of Commerce, Bureau of the Census, May 1980.

among the very old). Other factors may play a role here too, The 10 percent who refused to reveal their incomes may be disproportionately well off. The census data are not from the 1980 census (which was unavailable when the table was constructed) which presumably will show a higher percent of people with college educations than the earlier census estimates.

INTERVIEW BIASES

Item Nonresponse Bias

Respondents invariably fail to answer at least one question in an interview. This presents a problem when the analyst wishes to generalize from a sample to a population. Item nonresponse bias is the distortion in the estimate of the population characteristics for a variable caused by people failing to answer a question.

As noted earlier, this type of bias is the one which presented the greatest problem in this study. Considering only those who answered versions A, B, C (as has been our practice), 38 percent failed to answer for our WTP questions and 16 percent gave a $0 amount. Strictly speaking, the zero amounts are responses and we treated them as such, but they bear further analysis, Since other studies have found that a portion of the zero bids represent protest bids and not true zero valuations, it is appropriate to treat them here under the item nonresponse bias rubric.

Let us consider those who failed to give any amount first, In national surveys it is common for the don't knows to range from 5-10 percent for relatively demanding questions. This was the case with the questions which immediately preceded the WTP items in our questionnaire.

It asked respondents for their water quality preference and received an 11 percent nonresponse rate. In comparison, the 38 percent for the WTP items is obviously high. The three most likely explanations for this are: 1) The general difficulty of WTP questions; 2) The peculiar difficulty of our questions; 3) The interviewing situation for our study. We will discuss each in turn before concluding that a combination of the first and last of these factors is the most likely explanation for our high nonresponse rate.

WTP surveys are very demanding of respondents and it should not be surprising if, for comparable samples, they experience higher item non-response rates that surveys using more common types of question. The WTP instrument asks the respondent to attend to a description of the hypothetical market which is necessarily detailed. It requires the respondent to value in dollars an amenity the respondent does not customarily view in that manner. This is an intellectually demanding task and requires a motivational commitment which may be lacking for people for whom the public good being valued is not particularly salient. We reviewed 13 WTP studies to compare their item nonresponse rates on their WTP questions, Unfortunately, less than half of these studies provide enough information about item nonresponse to enable us to include them in the comparison. For the six which did, the rates ranged from 1 percent for Robert Davis' pioneering study of visits to the Maine woods (Knetsch and Davis, 1966) to 32 percent for a sales tax vehicle used to study the value of air visibility in the

Four Corner's area (Randall, et al., 1974). In between were item non-response rates of 2 percent (elk licenses, Brookshire, et al., 1980), 8 percent (damage from surface mining, Randall, et al., 1978), 11 percent, (air visibility, Brookshire, et al., 1980).[17] 14 percent (sales tax, Walsh, et al., 1978), 20 percent (utility bill, Brookshire, et al., 1980), and 21 percent (electric bill, Randall, et al., 1974).

These data suggest the following conclusions: 1) on the average, WTP studies tend to have somewhat higher item nonresponse rates than regular survey questions and yet 2) under certain conditions these rates are very low. In Davis' case, he personally conducted all his interviews in the Maine woods and reports very high rapport with his respondents. The elk license payment vehicle of Brookshire, et al. (1980) is specifically and traditionally tied to the good being valued. Because entrance fee vehicles have the same characteristics, we would also expect them to have low item nonresponse rates. Studies like ours which use bidding vehicles that are less specific or traditionally tied to the good may expect higher item nonresponse rates.

The second hypothesized cause of item nonresponse is our question wording. While we have identified minor changes which will make the questions clearer and more interesting to the respondents we are not aware of serious problems in this area. In our pretest with a specially trained interviewer only two people of 38 failed to give WTP amounts.

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[17] Neither of the last two studies specifically report item non-response rates. We infer these values from Randall, et al.'s, "unusable" survey figure and Brookshire, et al.'s "deletions" for reasons not explained (presumably because the respondents gave no amount.

The interview situation is another matter. We believe this is a major contributor to the high item nonresponse for several reasons, First, as noted earlier, we were able to obtain a national sample at low cost because we were able to add the benefits questionnaire to an existing survey, Because of this, as mentioned previously, the WTP instrument was administered after the respondents (and the interviewer) had already spent at least a half hour on the environment/energy survey. For certain categories of people, especially the aged and those with low levels of education, the preceeding interview probably took longer than a half hour with correspondingly greater fatigue effects. Second, because our budget was limited, (and our purposes experimental) we did not provide the interviewers with the kind of detailed instructions which we would provide for a full scale benefit estimation study. These instructions would include procedures for handling various types of respondent: queries and instructions for encouraging reluctant players to give WTP amounts. Third, the same budget constraints restricted the length of our WTP instrument. The addition of several followup questions in the instrument itself which would probe non-responses (and zero amounts) would enable us to identify respondents who would give us WTP amounts after further explanations.

To summarize, the most likely explanation for our high item non-response rate is a combination of the inherent difficulty of WTP questions, and the limitations of our interview situation. Appropriate changes in the latter, combined with a fine tuning of the questions, should reduce the item nonresponse rate to a tolerable level, Because of the inherent

difficulty of these types of questions, it will be very difficult to bring item nonresponse rates from 10-15 percent for WTP surveys of the general public. Rates of this level should not unduly bias the final estimates if weighting procedures are used to compensate for the nonrespondents. We discuss these matters further in Chapter 6.

How will our item nonresponse rate of 39 percent bias these data? Put another way, this question becomes: What kinds of people failed to respond to our WTP questions? We estimated a logit regression equation for a combination of background variables and key attitude items which is presented in Table 4.8. Definitions for these variables are given on Table 4.6, page 4-39 The dependent variable is a dummy with the non-respondents set at 1 and all those who gave WTP amounts greater than zero for fishable water at 0. (Thus we drop those who gave zero amounts from the following analysis). The overall predictive accuracy coefficient of .27 indicates a moderate fit. Older people, blacks and those who are uncertain about the nation's water quality goals (0.81 SPRECHLD) were especially likely (p. = .OO1> and those respondents low in income and education were very likely (p. = .O1> to be among the nonrespondents. The respondent's sex and use of water for recreation were also significantly related to the dependent variable. This profile is consistent with the hypothesis that people for whom the issue is less salient (SPRECHLD, RACED) and/or for whom the WTP instrument is difficult to answer(AGECAT, EDUC, SPRECHLD) are more likely to be among the nonrespondents to the WTP items. It is noteworthy that environmental and water quality attitudes (ENVINDEX, CNPOLD) are not significant in this equation.

Table 4.8

LOGIT[1] REGRESSIONS RELATING BACKGROUND AND ATTITUDINAL VARIABLES TO CERTAIN TYPES OF WILLINGNESS TO PAY RESPONSES FOR FISHABLE WATER[2]

Independent Variables	Dependent variable; 1 = zero wtp amount; 0 = WTP amount greater than zero	Dependent variable; 1 = 'don't know' how much willing to pay 0 = WTP amount greater than zero
Intercept	2.3**	2.8***
INCOMER	-.0002*	-.00002**
EDUC	-.42***	-.23**
AGECAT	.14**	.09***
RACED	-.95**	-1.38***
SEXD	-.10	.39*
USERD	-1.11***	-.44*
ENVINDEX	-.44***	-.08
CNPOLD	-.23	-.15
SPRECHLD[3]	-.96**	-1.68***
N	695	783
Likelihood ratio index	.31	.18
R^2 index (D)	.25	.19
Percent correctly predicted		
zero amounts	84%	don't know 77%
other amounts	86	other amounts 78
Predictive accuracy coefficient	.47	.27

* p < .05 / ** p < l .01 / *** p < .001

[1]Maximum likelihood estimates are computed by the Newton-Raphson method. (SAS Institute, 1980).

[2]For Versions A, B, and C combined.

[3]Dummy variable where 1 = nation should plan to achieve nationwide water quality of fishable or better within the next five years (Q.81); 0 = all other responses of which "not sure" comprises two-thirds and preference for nationwide water quality lower than fishable comprises one-twelfth.

From what we know about the willingness to pay for water quality of other respondents, the bias given our estimates by the high item non-response rate is upwards. The older, less educated and lower income people who expressed WTP amounts gave lower amounts, other things being equal, than their peers, and we would expect the addition of a significant number of the nonrespondents to those giving WTP amounts to lower the mean WTP value for water quality.

Turning now to the zero amounts, sixteen percent of our sample gave WTP amounts of $0 for fishable water. It is very difficult to compare this with the experience of other WTP studies since only four of the 13 studies reviewed report the total percent of $0 bids. For these studies the zero amounts varied as follows: 1 percent, Maine Woods (Knetsch and Davis, 1966); 2 percent for sales tax vehicle and 26 percent for utility bill option, water quality in the South Platte River Basin (Walsh, et al., 1978); 6 percent for non-reservation residents, air pollution visibility in Four Corner's area (Randall, et al., 1974); and 7-32 percent, depending on WTP version, decreased risk from nuclear plant accidents (Mulligan, 1978). Our level of zero amounts is somewhere in the middle of this distribution, but we do not regard this level of zero amounts as acceptable, especially since we already have a high non-response rate for the WTP questions.

The factors discussed above for nonresponse are also the likely cause of the zero amounts. Question wording probably played a much larger role in stimulating the zero responses, however. Endeavoring to legitimate low values for respondents who might have been hesitant to express their "true" feelings about water quality, we ended the first WTP question in the series by saying: "If it is not worth anything to you, please do not hesitate to say so." In retrospect we believe this was too strong a statement which unnecesarily promoted zero responses by some who probably have valued water at greater than zero but who were reluctant to undertake the mental effort necessary to arrive at that value. We will substitute another type of encouragement to respondents to give their true value in any future use of our instrument.

We estimated a logit regression for a dummy variable with zero WTP set at 1 and those who gave amounts greater than zero at 0. This regression is also reported in Table 4.7. This estimation has superior predictive power to the parallel one for nonrespondents (predictive accuracy coefficient of .47). Comparing the two equations we find recreational use and environmentalism play a greater role in predicting the zero bidders, who tend to use water less and are weaker in their support for environmentalism. These findings are consiste with the hypothesis that zero bids do represent low (if not zero) value for water quality. However, the importance of age, also significant in the equation at the .001 level, and the role of race and education (.01),

parallel their place in the nonresponse equation and suggests that zero bids may also be partially due to people protesting the WTP format or expressing an unwillingness to answer the question.

The bias introduced by the large number of zero bidders is to make our estimates lower than they would be if we had fewer zero bidders. From the findings of other WTP studies which have asked their zero bidders why they bid zero (Rowe, et al., 1979a; Thayer forthcoming, Brookshire, et al., 1980; Brookshire, et al., 1976) it seems very likely that some of our zero bidders are probably protesting the instrument rather than really valuing water quality at $0. An indeterminate number of the remaining zero bidders, while not protesting, nevertheless probably value water quality at least somewhat higher than $0 and could be induced to bid higher by the changes described above.

(continue)

Interview Procedure and Interviewer Biases

Two other interview method biases remain to be discussed. The interview procedure-bias refers to bias introduced by the manner of conducting the interview. Interviewing takes place by either personal interview, telephone or mail. The differences involved in choosing between these methods including cost, return rate, ease of asking sensitive questions, and ease of asking complex questions. Although it is the most expensive method, the personal interview method is superior to the other methods on all dimensions (Dillman, 1978:74-76; on social desirability see Bradburn and Sudman, 1979:8). The personal interview method is especially preferable for WTP surveys because it permits the researcher to use visual displays such as our ladder and payment cards and it is the most successful of these methods when the questions are potentially tedious and boring (Dillman, 1978:75). The only viable alternative would be the mail survey, a method used only twice in a WTP study to our knowledge (Bishop and Heberlein, 1980; Fish and Wildlife Service, 1975) as the need to create the hypothetical market in sufficient detail is too wordy for phone interviews.

Unlike the mail surveys, personal interview surveys are open to potential interviewer bias. This type of bias consists of differential effects introduced by the individual interviewers. In a bidding game, for example, some interviewers may be more skillful in inducing respondents to increase their bids above the starting point more than others. If a study uses relatively few interviewers who conduct 25 interviews or more, it is possible to test for interviewer effects by holding the respondents'

personal characteristics (such as income) constant and comparing the mean WTP amounts to see if they differ significantly. Because Roper used 100 interviewers scattered across the country to conduct our interviews, the number of interviews per interviewer is too few to conduct this type of test. With that many interviewers we would expect individual interviewer effects, if there are any, to average out. There is always the possibility that the interviewer training may induce all the interviewers in a project to obtain higher bids than interviewers trained by someone else might with the same questionnaire, but there is no easy way to test for this other than to conduct elaborate methodological experiments. One advantage of our payment card technique is that it minimizes the potential interviewer effect on the WTP amount as compared with the bidding game method.